Response to Reviewers

We thank the reviewers for their comments, which helped to improve the manuscript. We answer each comment and how we changed the MS accordingly. Please note, that the values of the new global calculations changed slightly because we ran the re-calculations with a 20km grid resolution and modified the global map from shape to grid format to allow for faster calculations.

We would kindly ask to delete "Short Communication" in the title.

Response to Referee 1:

1) it is somehow surprising that the weathering of old basaltic surfaces does not depend on the local runoff value. The "expected" weathering law only depends on temperature, based on the plot displayed on fig 1b. Would it be useful to plot the CO2 consumption by the weathering of old basaltic outcrop as a function of runoff ?	These patterns were already analyzed in Li et al. (2016). The temperature normalization is used here, because of the robustness of the pattern. The correlation between runoff and alkalinity flux rates is weaker than using temperature. This still holds if including the uncertainties of the data (with Monte Carlo type analysis, R^2=0.96, p<10^{-3}, using a linear regression for observed alkalinity flux rates and calculated alkalinity flux rates using the new temperature scaling law). Considering the Monte Carlo type application, the correlation between runoff and alkalinity flux rates becomes even weaker, if compared to a regression analysis using only the single data points. It is not concluded that runoff plays not a significant role for determining basalt weathering rates. However, the correlation between runoff and alkalinity flux rates is not significant any longer when Inactive Volcanic fields (IVFs) and Active Volcanic Fields (AVFs) are considered separately (new Figure 2c) (Li et al., 2016). We included a figure showing the runoff/alkalinity relationship of old volcanic fields, now in the main text (Fig.2c).
2) The authors implicitly assume that the young volcanic area are basaltic. This is not always the case (see for instance Rad et al., 2013, J South Am Earth Sci) . There is a possibility of bias in the present database: the old surfaces being basaltic, while the young volcanic areas can be dominated or affected by an andesitic lithology.	We consider now only mapped areas in catchments that were clearly described as "basaltic" or dominated by basalt. We included this part in the discussion in line 185-191: "The lithologies, predominantly described as basaltic in the global map, might introduce an additional bias to the global calculations because heterogeneities in the lithology cannot be excluded. Two active

	volcanic fields (Sao Miguel and Tianchi Lake) were excluded from the calculation of the scaling law function because available catchments with alkalinity data hold largely lithologies of trachytic composition. Nevertheless, their data points (Fig. 1c) seem to show the same weathering behavior.”
3) There is no discussion about the contribution of ash weathering to the alkalinity flux. Ashes released by active volcanoes may represent an important contributor to the CO2 consumption by weathering given their high reactive surfaces and their content in glass (see for instance Sowards et al., 2018, Geosphere). I think this should discuss.	We agree with this and included it in line 140-143 in the discussion: “Volcanic ashes and ejecta might contribute to elevated weathering fluxes because of a relatively high content of glass. Glass dissolution rates are relatively high compared to mineral dissolution rates in general, but base cation content release varies dependent on the Si:O ratio (Wolff-Boenisch et al., 2006).” We agree that volcanic ashes provide fresh weatherable material on top of the basaltic rocks.

Response to Referee 2 (R. Emberson):

1. I think it is imperative that the authors provide uncertainty / error estimates on all of their results, and describe how these estimates were made (probably in the supplemental material). Without estimates of uncertainty, the reader is unable to assess the significance of the results. Even if the uncertainty on the measurements has already been made in the prior work (Li et al. 2016), I feel it’s essential that the authors also show these estimates (and additionally explain again how these estimates were derived – see comment number 5 for further discussion). Specifically, I’d like to see uncertainty estimates attached to all plotted points in the figures, in equations 2 and 4, and in the estimates in Table 1.	We agree with this and included the uncertainty estimates by Li et al. (2016) in all figures where it was possible. It is not possible to give a suitable uncertainty for the mapping accuracy of the Holocene fraction due to the nature of the data. We calculated the mean residual standard deviation of the newly derived function using a Monte Carlo method and show the standard deviation in eq.2 and 5. The calculation of the mean residual standard deviation is described in the supplemental material. The values of the global calculation of the CO_2 consumption fluxes were calculated by applying each 10,000 (Levenberg-Marquardt-algorithm) non-linear correlations to a new global basalt map and global datasets of temperature and runoff (Fekete et al., 2002; Hijmans et al., 2005). From this we calculated the mean global values of the fluxes, their standard deviations and percentiles (25, 75) (Supplemental Material F in the supplemental material).

2. The different behavior of IVF and AVF areas based on reactivity is a novel way to explore the basaltic weathering regime, but perhaps it would be useful for some read- ers if the authors also explained this in the context of supply-limited or kinetic-limited weathering (e.g. Ferrier et al. 2016 Geochemistry Geophysics Geosystems). The IVF behavior shown in Fig 1b certainly looks like classic kinetic-limited weathering, but as the authors point out in the AVF this relationship no longer holds. I would suggest plot- ting the AVF data in the same way as the IVF data in Fig 1b. to see if there is a similar kinetically-limited relationship; if so, this could indicate that the boundary conditions for the kinetically limited system differ (e.g. due to less clay precipitation in younger lava bodies), whereas if such a kinetically-limited behavior is not evident (or the residuals are very large) then perhaps other effects (e.g. magmatic CO2 degassing) may be relevant. Showing the reader these data could help demonstrate the effects seen, as well as making the relationships easier to understand for geochemists who work in the kinetic/supply limited paradigm.	The new Fig.2d shows the IVFs and AVFs combined in a temperature/alkalinity plot. The scattering in the plot shows that there is no classic kinetic-limited weathering visible for AVF, while, as described, the IVF follow an apparent temperature dependency. Taking into account that the four AVFs Mt. Etna, Mt. Cameroon, Virunga and La Reunion have the highest Holocene fractions (96.6%-27.7%) and all the other AVFs , which have less than 15% Holocene coverage, supports the argument that elevated geothermal fluxes, magmatic CO_2 and fresh material supplied on top of the classical critical zone contribute to enhanced alkalinity fluxes of these volcanic fields, as supported by referenced studies. Therefore, the classical concept of supply versus kinetic limitation in tectonic context and referring to a "shallow" critical zone as discussed in Ferrier et al. (2016) does not work here. We included some discussion for this before pointing out the relevance of intra-volcanic weathering (not the shallow critical zone), and the supply of fresh material due to volcanic activity. We include the reference of Ferrier et al. (2016) now and added a discussion part as pointed out by the reviewer.
3. The authors explain that they use the Holocene transition as a way to split the AVFs from the IVFs. This makes sense in terms of data availability, and I think it is an appropriate (if arbitrary) way to separate the data. However, the Holocene transition involved a series of global climatic changes, and I think it would be useful for the authors to explore whether this transition and the climatic changes associated with it could explain the differences observed in 'reactivity' between pre and post Holocene basaltic fields. I appreciate that the AVF and IVF areas both experience the same climate today, but I think it would be at least useful to discuss whether or not there could be a legacy effect in the IVF areas from weathering under a different climatic regime.	Our study is based on today's climate conditions and it is unknown how different climate regimes in the past may have influenced the basalt weathering fluxes due to the lack of data on the distribution of young surface areas in the past. This point is difficult to address since we have only observation data of today and it is not possible for now to reconstruct active volcanic areas for the past in a global compilation. After times of globally warmer climate and higher erosion rates, the difference in reactivity between IVFs and AVFs might be reduced, but we lack information for this in our global compilation of data. Furthermore, we calculated global fluxes for the Mid-Holocene using Earth System model outputs, comparing the different alkalinity flux models. The calculations show that models, which consider only runoff as parameter provide elevated fluxes in the Mid-Holocene, of 8 %, due to slightly higher global runoff values (Bluth and Kump, 1994; Amiotte-Suchet and Probst, 1995), while models considering temperature and runoff provide lower values (-32 to 36%; (Dessert et al., 2003; Goll et al., 2014).

	Considering only temperature (new scaling equation developed for today's settings) results in only small differences in the global weathering fluxes of 10% compared to today, for areas with > 74 mm/a runoff. These calculations are based on highly speculative assumptions, like geographical distribution of active volcanic areas are as today. Specifically, we do not know the Holocene-equivalent area if using mid-Holocene as reference point for example. Therefore, we are not sure, what the reviewer wants us to do here. We do not understand how a "legacy" effect can be identified based on the available data and how this could be quantified. Therefore, we would like to keep this calculation out of the manuscript.
4. It would be helpful to provide detail of the water chemistry measurements or data involved in this study in the supplemental material. From the information provided, it is not possible for the reader to tell how variable the HCO3-measurements made were, which makes it hard to judge the estimates of CO2 sequestration. While I appreciate that a full assessment of the chemical composition of the rivers in question is significantly outside the scope of the study, it would be helpful for clarity if the authors discussed the following points, either in main or supplemental text: How variable is the HCO3 in the water? Are the rivers super-saturated with respect to calcite? This is a fairly important issue, as there is potential for secondary carbonate precipitation to form in the rivers and soils of a catchment, which means the final estimates of HCO3 flux may be biased. What are the concentration – discharge relationships for HCO3 in these rivers? If concentration is relatively high even at high discharge (i.e. are the rivers near-chemostatic? - e.g. Godsey et al. 2009, Hydrological Processes) then the largest storm events have the greatest importance for HCO3 flux – and as a result, changes in climate across the Holocene transition (e.g. different storm frequency) may be relevant for the findings (see point 3 above). As I say above, I fully appreciate that data on these points may be lacking, and certainly addressing these points in full is outside the scope of this study – I would just suggest	We tried to address this important point here and put some sentence into the supplement: For six areas water chemistry data are available (High Cascades, Japan, NE North America, SE Australia, South Africa and Tasmania), while for others either pH or major cations were not available. For these available data (103 catchments) the saturation index for calcite was calculated. In general, water samples are undersaturated with respect to calcite (77%). From the oversaturated samples 50% have values close to 0 with an saturation index SI < 0.5. SI ~ 0.5 is the typical value for rivers in limestone areas (Romero-Mujalli et al., 2018). The other 12 values are between SI=0.5 and 0.9 and according water sample locations are mostly in dry areas of South Africa or Australia. In general, younger active areas have significant contributions of magmatic SO_4 or Cl, which shifts the saturation states normally further to lower, negative values. We cannot conclude from the river data what happens in the aquifer system but reference the study of Jacobson et al. (2015), which quantified the contribution of trace calcite dissolution from basalt using Ca-isotope data.

explaining how these issues may relate to your results, and what your assumptions are with regards to the river chemistry. This would really help the reader appreciate the results. A discussion of the assumptions could be incorporated into supplemental material.	
5. This study is a useful addition to the study of Li et al. (2016), from which much (if not all?) of the data seems to be drawn. While I appreciate that the prior work is a published study, I think it is important that the authors explain their methodology in this publication too. For example, it would be useful to explain how alkalinity calculations were made, and some of the assumptions associated with the chemistry data; it would also be useful to summarise all of the uncertainty estimates made in that prior study in this study (see point 1). I notice that the Li et al. 2016 paper is open-access (much appreciated!), so I can appreciate that some researchers may feel it is sufficient to just cite the methods in the prior work. My personal preference is for as much of the relevant methodology for a given study to be described in that study as possible, but I leave this to the editor's discretion in this case.	Li et al. (2016) calculated the alkalinity flux rates by multiplying the mean concentration of dissolved inorganic carbon (DIC) by the annual runoff. We included this explanation in the supplemental material. However, because the supplement is already very long, and the other data file is open access online, we would like to avoid replicating the data since the supplement is already rather long with over 40 pages, explaining the new data and calculations. Table S1 summarizes the hydrochemical data per volcanic area.
6. A small point, but one I feel worth mentioning – the HCO3/reactivity figures in the supplementary material (lines 188-189) are a really useful accompaniment to Figure 1 in the main text, and I would suggest incorporating at least some of them into the main text. It really helped me understand the importance of temperature and runoff, and I think they're important enough to include. Even if you choose not to do so, it would be useful to ensure that the symbology in the figures corresponds to one another (i.e. red-blue points in the main text, red-green points in the supplement). I'd suggest using red-blue as in the main text, to avoid any issues with red-green colour blind readers.	We incorporated two of the figures in the main text and changed the colors to blue and red (now new: Figure 2a to 2d compare the relationships).

7. It may be useful to compare these findings to those relating to weathering in aging glacial moraines, to help contextualize the importance of aging? Your results are really intriguing, and provide impetus for research questions focused on e.g. weathering in lava flows of known age (via e.g. cosmo dating) and comparing to glacial moraines would be direct comparison.	Indeed, we included a reference from Taylor and Blum (1995), discussing this in the introduction, lines 44-45.
8. In line 40, you refer to 'geogenic nutrients'. I think this is a jargon term that many readers won't understand; I'd suggest defining this term before you use it. Additionally, I think this statement needs a citation to support it.	This is a normal scientific use of common terms geo and genic. Geogenic means here derived from rock/lithosphere, comparable to the term anthropogenic.
9. In a couple of locations, you separate the arid and non-arid locations based on a rainfall total of >74mm per year – why was this figure chosen? It would be helpful to have some explanation as to this number.	As we explained in the text before 74 mm a^{-1} was the lowest runoff value of a volcanic field in the dataset of Li et al. (2016). We included an explanation in line 109-114 and show in the summary table of model comparison that the cutoff is necessary to avoid overestimation due to the temperature scaling law used.
10. I would suggest arranging references in chronological order where there are multiple citations in parentheses, e.g. Line 43 and other locations.	We agree with this point.
Typographical / Syntax points In general I found the paper to be well written and easy to read. There are a handful of places where the language is somewhat idiosyncratic, and I've tried to make suggestions where possible. As a general point I would recom- mend using the active voice rather than passive voice to improve readability, but that's probably a matter of personal preference.	Thank you very much.
Line 12: Consider being more specific than the word 'information' – perhaps describe which types of data you mean.	We rewrote this sentence.
Line 20: Instead of "from surface near material in the critical zone", consider "from material in the shallow critical zone"	We agree and changed it correspondingly.
Line 22: Remove comma after suggests	We deleted the comma.
Line 23: "Active basalt areas" is jargon – I'd suggest it's best to define what you mean in the main text	We deleted "active".

and avoid using jargon terms in the abstract	
Line 30: “Basalt areas, despite its limited. . .” should be “Basalt areas, despite their limited. . .”. Also remove the ‘the’ before CO2.	We agree and changed it.
Line 39-40: Consider changing “The role of basalt weathering in the carbon cycle and its feedback strength in the climate system depends, besides the release of . . .” to “The importance of basalt weathering in the carbon cycle and the climate-weathering feedback loop depends in part on the release of geogenic nutrients but crucially on the amount of associated. . .”	We changed it to: “The role of basalt weathering in the carbon cycle and its feedback strength in the climate system depends, besides the release of geogenic nutrients, on the amount of associated CO_2 consumption and related alkalinity fluxes.”
Line 59: Replace “However, the here suggested aging effect” with “However, the effect of aging on weathering rates from a volcanic system discussed here has not been evaluated.”	We replaced this part.
Line 68: Consider replacing “the fraction of the Holocene area on the total studied area” with “the proportion of total area occupied by Holocene lavas”	We changed this part.
Line 92-93: The word order and verb agreement in this sentence is somewhat unclear – I haven’t suggested a revision since I don’t want to mess with the meaning, but I’d suggest revising it to clarify what you mean.	We modified this part.
Line 100: Replace “For allowing comparison with” with “to allow for comparison with”	We replaced this.
Line 103: Replace ‘reporting’ with e.g. ‘describing’	We agree and changed it.
Table 1: The first two columns in the table have no label? Please add a label to explain what these are.	We changed the labels of the table.
Line 152: Consider changing the phrase ‘time stamp’ – it isn’t necessarily clear what you mean.	We replaced it by “time period”.
Line 159: Replace ‘Results’ with “Our results”. Also change ‘considering’ to ‘exploring’	We changed this part.
Line 160: ‘Displacement’ – do you mean ‘emplacement’?	We replaced it.
Line 164: I would suggest rephrasing to remove the comma.	We modified this part.

Final paragraph: Consider re-stating your key finding in the final paragraph.	We rewrote this part.
Supplementary Material: Generally I found the supplementary material to be clear and helpful. Please ensure that uncertainty estimates are included where possible. I would also suggest checking with the editor as to whether the citations in the supplementary material will be indexed or not – it may be advisable to move them to the main text to ensure they get indexed.	Uncertainty estimates are now included in the supplemental material.

References:

Amiotte-Suchet, P., and Probst, J. L.: A global model for present-day atmospheric/soil CO2 consumption by chemical erosion of continental rocks (GEM-CO2), Tellus B, 47, 273-280, 10.1034/j.1600-0889.47.issue1.23.x, 1995.

Bluth, G. J., and Kump, L. R.: Lithologic and climatologic controls of river chemistry, Geochimica et Cosmochimica Acta, 58, 2341-2359, 1994.

Dessert, C., Dupré, B., Gaillardet, J., François, L. M., and Allègre, C. J.: Basalt weathering laws and the impact of basalt weathering on the global carbon cycle, Chemical Geology, 202, 257-273, http://dx.doi.org/10.1016/j.chemgeo.2002.10.001, 2003.

Fekete, B. M., Vörösmarty, C. J., and Grabs, W.: High-resolution fields of global runoff combining observed river discharge and simulated water balances, Global Biogeochemical Cycles, 16, 2002.

Ferrier, K. L., Riebe, C. S., and Jesse Hahm, W.: Testing for supply-limited and kinetic-limited chemical erosion in field measurements of regolith production and chemical depletion, Geochemistry, Geophysics, Geosystems, 17, 2270-2285, 2016.

Goll, D. S., Moosdorf, N., Hartmann, J., and Brovkin, V.: Climate-driven changes in chemical weathering and associated phosphorus release since 1850: Implications for the land carbon balance, Geophysical Research Letters, 41, 3553-3558, 10.1002/2014GL059471, 2014.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G., and Jarvis, A.: Very high resolution interpolated climate surfaces for global land areas, International journal of climatology, 25, 1965-1978, 2005.

Jacobson, A. D., Grace Andrews, M., Lehn, G. O., and Holmden, C.: Silicate versus carbonate weathering in Iceland: New insights from Ca isotopes, Earth and Planetary Science Letters, 416, 132-142, http://dx.doi.org/10.1016/j.epsl.2015.01.030, 2015.

Li, G., Hartmann, J., Derry, L. A., West, A. J., You, C.-F., Long, X., Zhan, T., Li, L., Li, G., Qiu, W., Li, T., Liu, L., Chen, Y., Ji, J., Zhao, L., and Chen, J.: Temperature dependence of basalt weathering, Earth and Planetary Science Letters, 443, 59-69, http://dx.doi.org/10.1016/j.epsl.2016.03.015, 2016.

Romero-Mujalli, G., Hartmann, J., and Börker, J.: Temperature and CO2 dependency of global carbonate weathering fluxes – Implications for future carbonate weathering research, Chemical Geology, https://doi.org/10.1016/j.chemgeo.2018.08.010, 2018.

Taylor, A., and Blum, J. D.: Relation between soil age and silicate weathering rates determined from the chemical evolution of a glacial chronosequence, Geology, 23, 979-982, 1995.

Wolff-Boenisch, D., Gislason, S. R., and Oelkers, E. H.: The effect of crystallinity on dissolution rates and CO2 consumption capacity of silicates, Geochimica et Cosmochimica Acta, 70, 858-870, 2006.

~~Short Communication:~~ Aging of basalt volcanic systems and decreasing CO_2 consumption by weathering

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Abstract

Basalt weathering is one of many relevant processes balancing the global carbon cycle via land-ocean alkalinity fluxes. The CO_2 consumption by weathering can be calculated using alkalinity and is often scaled with runoff and/or temperature. Here it is tested if ~~information on~~ the surface age distribution of a volcanic system derived by geological maps is a useful proxy for changes in alkalinity production with time.

A linear relationship between temperature normalized alkalinity fluxes and the Holocene area fraction of a volcanic field was identified, using information from 33 basalt volcanic fields, with an r^2=0.~~91~~93. This relationship is interpreted as an aging function and suggests that fluxes from Holocene areas are ~10 times higher than those from old inactive volcanic fields. However, the cause for the decrease with time is probably a combination of effects, including a decrease in alkalinity production from ~~surface near~~ material in the shallow critical zone as well as a decline in hydrothermal activity and magmatic CO_2 contribution. The addition of fresh reactive material on top of the critical zone has an effect in young active volcanic settings which should be accounted for, too.

A comparison with global models suggests~~,~~ that global alkalinity fluxes considering Holocene ~~active~~ basalt areas are ~~~70~~60% higher than the average from these models imply. The contribution of Holocene areas to the global basalt alkalinity fluxes is today however only ~~~6~~5%, because identified, mapped Holocene basalt areas cover only ~1% of the existing basalt areas. The large trap basalt proportion on the global basalt areas today reduces the relevance of the aging effect. However, the aging effect might be a relevant process during periods of globally, intensive volcanic activity, which remains to be tested.

1. Introduction

Basalt areas, despite ~~its~~their limited areal coverage, contribute significantly to ~~the~~ CO_2 sequestration by silicate rock weathering (~~Dessert et al., 2003;~~ Gaillardet et al., 1999; Dessert et al., 2003; Hartmann et al., 2009). The sensitivity of basalt weathering to climate change (~~Coogan and Dosso, 2015; ~~Dessert et al., 2001; Dessert et al., 2003; Coogan and Dosso, 2015; Li et al., 2016) supports a negative weathering feedback in the carbon cycle that maintains the habitability of the Earth's surface over geological time scales (Walker et al., 1981; Berner~~,~~ et al., 1983; Li and Elderfield, 2013~~; Walker et al., 1981~~). Changes in volcanic weathering fluxes due to emplacement of large volcanic provinces or shifts in the geographic distribution of volcanic fields associated with continental drift may have contributed to climate change in the past (Goddéris et al., 2003; Schaller et al., 2012; Kent and Muttoni, 2013~~; Schaller et al., 2012~~).

The role of basalt weathering in the carbon cycle and its feedback strength in the climate system depends, besides the release of geogenic nutrients, on the amount of associated CO_2 consumption and related alkalinity fluxes. The factors that module these fluxes are a subject to uncertainty. Previous studies suggest that basalt weathering contributes 25–35% to the global silicate CO_2 consumption by weathering (~~Dessert et al., 2003; ~~Gaillardet et al., 1999; Dessert et al., 2003; Hartmann et al., 2009). However, their estimations do not consider the potential aging of a weathering system~~.~~ (e.g., Taylor and Blum, 1995). Young volcanic areas can show much higher weathering rates compared to older ones, as was shown for the Lesser Antilles, where a rapid decay of weathering rates within the first 0.5 Ma was observed (Rad et al., 2013). Such an aging effect of volcanic areas is difficult to parameterize for global basalt weathering fluxes, due to a lack of global compilations.

A practical approach to resolve this issue is to distinguish ~~old~~older and inactive volcanic fields (IVF) and active volcanic fields (AVF) (Li et al., 2016) and compare weathering fluxes with factors driving the weathering process, like land surface temperature or hydrological parameters. By compiling data from 37 basaltic fields globally, Li et al. (2016) showed that spatially explicit alkalinity fluxes (or CO_2 consumption rates) associated with basalt weathering correlate strongly with land surface temperature for IVFs, but not for AVFs. They suggested that previously observed correlations between weathering rates and runoff in global datasets originates partly from the coincidence of high weathering rates and high runoff of AVFs rather than a direct primary runoff control on the weathering rate. Many studied AVFs are located near the oceans and have an elevated topography, a combination, which can cause elevated runoff due to an orographic effect (Gaillardet et al., 2011). However, the ~~here suggested~~effect of aging ~~effect ~~on weathering rates from a volcanic system discussed here has not been evaluated.

The age distribution of the surface area of a whole volcanic system might be used as a first order proxy to study the variability of weathering fluxes of AVFs. However, the exact surface age of volcanic areas is rarely mapped in detail, but Holocene areas are often reported in geological maps. Here, basalt alkalinity fluxes are related to the calculated Holocene areal proportion of volcanic fields at the catchment scale. For this, the concept of weathering reactivity is introduced, which is the relative alkalinity flux of AVFs to the alkalinity flux estimated for IVFs~~ by the function identified in Li et al. (2016). This reactivity R is compared with the relative age distribution of surface areas, using the fraction of the Holocene area on the total studied area.~~. This reactivity R is compared with the relative age distribution of surface areas, using the proportion of total area occupied by Holocene lavas. From this comparison a function for the decay of alkalinity fluxes with increasing proportion of older land surface area is derived and discussed.

2. Methods

The volcanic fields used to establish the relationship between weathering reactivity and Holocene coverage are predominantly described as basalt areas (Li et al., 2016). Based on the availability of detailed geological maps, 33 volcanic provinces were selected, with 19 IVFs and 14 AVFs. A detailed description is given in the supplementary information. The 14 AVFs are geographically widespread and diverse (Fig.1a). If the absolute age distribution of the volcanic rocks is available, the Holocene areas were mapped using the age range from 11.7 ka to present, according to the International Commission on Stratigraphy version 2017/02 (Cohen et al., 2013). If possible, coordinates of water sample locations were used to constrain catchment boundary to calculate the Holocene fraction for monitored areas. In ~~some~~all cases already existing alkalinity flux calculations were taken from Li et al. (2016). Detailed information on additional mapping and calculations for each system can be found in the supplementary information (SI).

~~The weathering reactivity (R) of each volcanic field is calculated by normalizing the observed alkalinity flux of the AVF ($F_{observed}$, in 10^6 mol km^{-2} a^{-1}) to that of the expected flux if the AVF would be an IVF ($F_{expected}$) applying the previously identified weathering function for IVFs (Li et al., 2016):~~

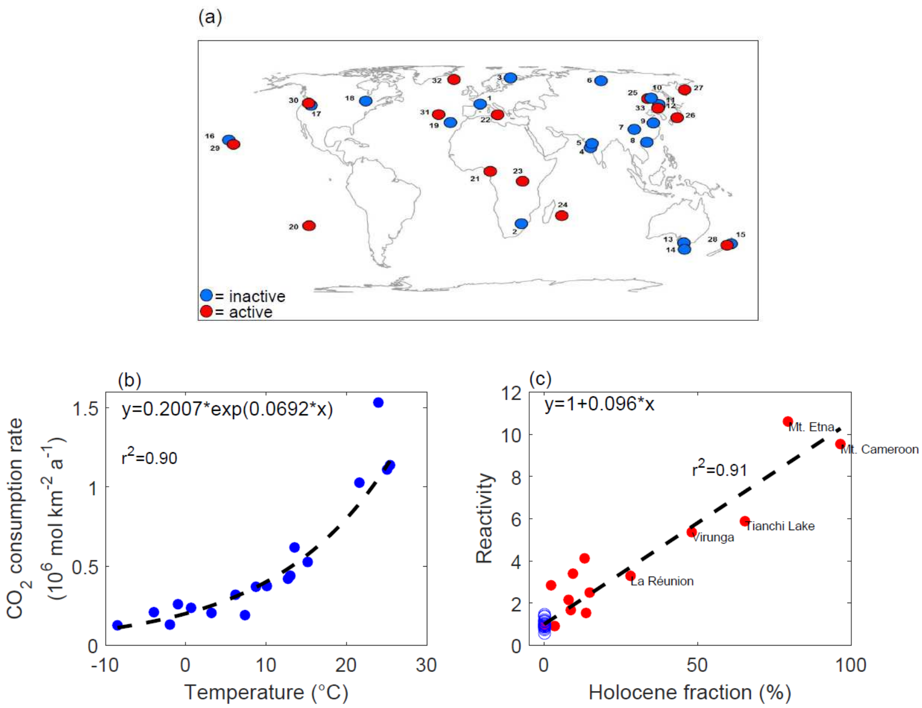
~~$R = F_{observed}/F_{expected}$ (eq. 1)~~

The weathering reactivity (R) of each volcanic field is calculated by normalizing the observed alkalinity flux of the AVF ($F_{calculated}$, in 10^6 mol km^{-2} a^{-1}) to that of the expected flux if the AVF would be an IVF ($F_{expected}$):

$$R = \frac{F_{calculated}}{F_{expected}} \quad \text{(eq.1)}$$

where the expected alkalinity flux $F_{expected}$ for IVFs is given by the function (Fig. 1b):

~~$F_{expected}$ (10^6 mol km^{-2} a^{-1}) = $0.2007 \times e^{(0.0692 \times T (°C))}$ (eq. 2)~~



$$F_{expected}\,(10^{6}\,mol\,km^{-2}a^{-1}) = 0.23 * e^{(0.06*T\,(°C))}\text{, standard deviation = 0.3} \qquad \text{(eq.2)}$$

The parameters of the equation were derived by using a Monte Carlo method, simulating 10,000 runs (for more information see Supplementary Information).

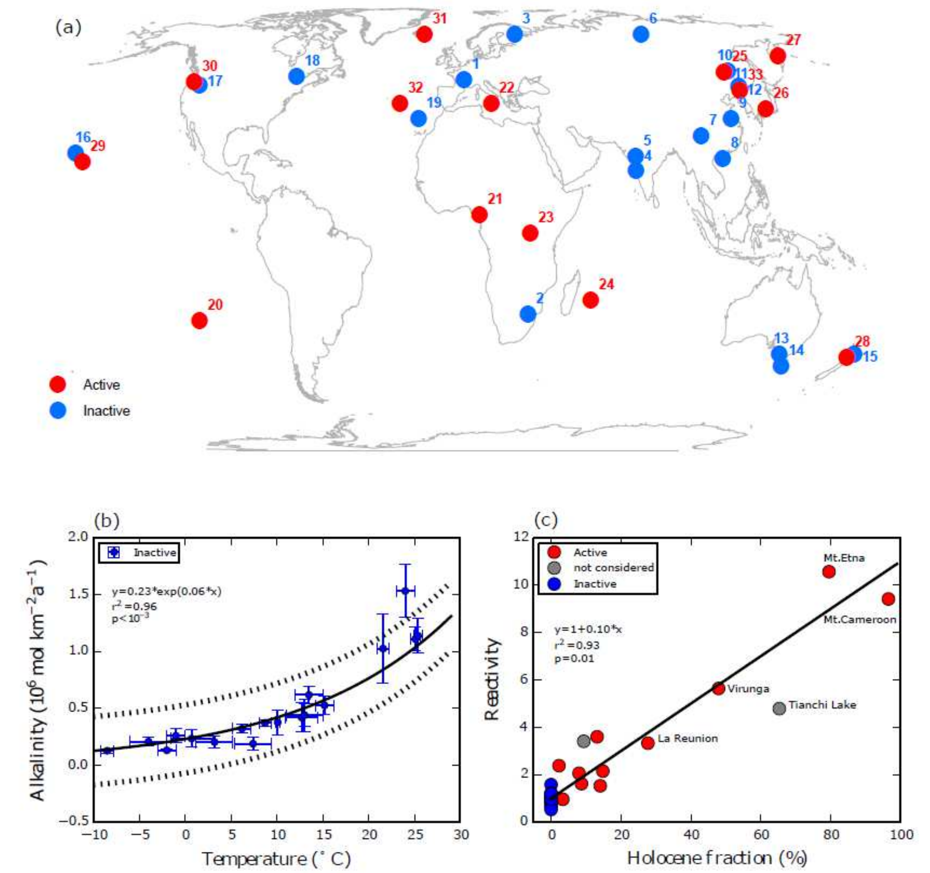


Figure ~~1. (~~1(a) The global map shows the locations of the Active Volcanic Fields (in red) and the Inactive Volcanic Fields (in blue) used in this study (1.Massif Central, 2.South Africa, 3.Karelia, 4.Coastal Deccan, 5.Interior Deccan, 6.Siberia Traps, 7.E'Mei, 8.Lei-Qiong, 9.Nanjing, 10.Xiaoxinganling, 11.Tumen River, 12.Mudan River, 13.SE Australia, 14.Tasmania, 15.North Island, NZ, 16.Kauai, Hawaii, 17.Columbia Plateau, 18.NE America, 19.Madeira Island, 20.Easter Island, 21.Mt.Cameroon, 22.Mt.Etna, 23.Virunga, 24.La Réunion, 25.Wudalianchi Lake, 26.Japan, 27.Kamchatka, 28.Taranaki, 29.Big Island, Hawaii, 30.High Cascades, 31.~~Sao Miguel, 32.Iceland, 33.Tianchi Lake). (b) The exponential relationship between alkalinity flux rates and the land surface temperature for IVFs (Li et al., 2016). (c) The relationship between the Holocene area fraction of a volcanic field and the weathering reactivity R (r^2=0.91).~~Iceland, *32.Sao Miguel, 33.Tianchi Lake). (b) The exponential relationship between area specific alkalinity flux rates and the land surface temperature for IVFs. The dashed lines represent the range of the mean residual standard deviation of the function (see Supplementary Information). Note that r^2 and the p-value were derived by a linear regression of calculated alkalinity flux rates vs. estimated alkalinity flux rates using the new scaling law. (c) The relationship between the Holocene area fraction of the used watersheds from the volcanic fields and the weathering reactivity R. Note that "Tianchi Lake" and "Sao Miguel" are excluded from the calculation of the regression line because the applied catchments where not dominated by basalt but by trachytic volcanic rock types. Both data points still seem to follow the identified regression trend line for AVFs. R^2 and p-value were calculated by a linear regression of the Holocene fraction vs. reactivity for all AVFs.*

IVFs ~~range~~group around a reactivity R=1 in Fig. 1c, while having a Holocene fraction of zero ~~(Fig 1c).~~. The reactivity R (eq. 1) of an AVF can be estimated by the Holocene area fraction as implied by the ~~good~~significant linear correlation identified in Fig. 1c. The ~~virtual~~theoretical reactivity ~~for~~of a 100% Holocene ~~areas can~~area H might be estimated ~~rearranging eq. 1~~by the equation given by Fig. 1c substituting y and x and setting ~~the area fraction~~H to 100~~%~~ :

~~$F_{Holocene} = R_{100\%}$~~

$$R_{100\%\ Holocene} = 1 + 0.10 * H = 11 \qquad \text{(eq.3)}$$

And with this the flux from a young system of only Holocene ~~$* F_{expected}$~~ ~~(eq. 3)~~age:

$$F_{Holocene} = R_{100\%\ Holocene} * F_{expected} \qquad \text{(eq.4)}$$

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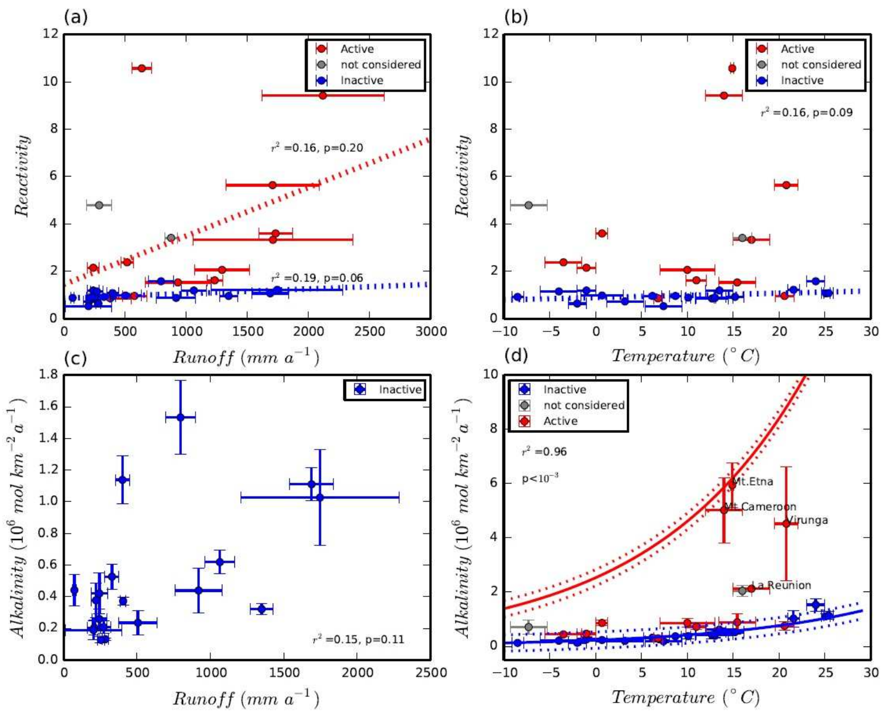

Figure 2(a) shows the runoff-reactivity relationship of all studied volcanic fields. The blue regression line (IVFs) suggests almost no correlation of reactivity with runoff, also for the AFVs no significant correlation is identified (coefficient of determination $r^2=0.16$ ($p=0.20$)) (b) Reactivity versus temperature suggests no bias of reactivity due to a temperature effect for AVFs, as reactivity is based on a temperature normalized parameterization. For the IVFs ($r^2=0.16$, $p=0.09$) no bias with temperature can be identified due to the good correlation of alkalinity fluxes with land surface temperature (blue line) (c) Runoff versus alkalinity flux rates for inactive volcanic fields shows no significant correlation ($r^2=0.15$, $p=0.11$) (d) Temperature versus alkalinity flux rates for all volcanic fields of the study. The blue line represents the new scaling law for IVFs and the red line the new scaling law for AVFs with 100% Holocene area coverage (calculated deviation is represented by dashed lines). R^2 and p-value are derived by a linear regression of calculated alkalinity flux rates vs. observed alkalinity flux rates for all volcanic fields.

Global alkalinity fluxes from basalt areas arewere calculated by using equation 2 for older areas than of Holocene age and equation 2 and4 for mapped Holocene areas equation 3. The model .

These equations are(eq.2 and following, using information based on eq.2) were calibrated for areas with a runoff > 74 mm a^{-1} (lowest runoff value in data compilation of Li et al. (2016) and therefore limit of the model setup) to avoid too high alkalinity fluxes from drier areas with high temperature (*e.g.*, the Sahara Desert), assuming that neglecting fluxes from areas with lower runoff are not biasing the comparison (Tab. S1, supplementary information). In this case an overestimation is avoided. For the global calculation of CO_2 consumption by the new scaling law, a Monte Carlo method simulating 10,000 runs was applied (see supplement information).

Results are compared with four previous global empirical alkalinity flux models (Bluth and Kump, 1994; Amiotte-Suchet and Probst, 1995; Dessert et al., 2003; Goll et al., 2014; Suchet and Probst, 1995). Alkalinity fluxes were translated into CO_2 consumption to allow for allowing comparison with previous literature. For all models the same data input was used: a newly compiled global basalt map (mostly derived by the basalt lithological layer from the GLiM, but enhanced by mapped Holocene areas (SI; Hartmann and Moosdorf, 2012), additional regional geological maps reporting ondescribing basalt areas and the maps of the volcanic fields used in this study, for detailed information see supplementary information), temperature (Hijmans et al., 2005) and runoff (Fekete et al., 2002).

3. Results and Discussion

Studied IVFs are characterized by a Holocene volcanic surface area of 0% with weathering reactivity R ranging between 0.65 and 1.56 (Fig. 1c). In contrast, AVFs show a large range of Holocene coverage, from 0.2% (High Cascades) to 96.6% (Mount Cameroon), and weathering reactivity between 0.9 (Easter Island, High Cascades) and 10.6 (Mount Etna). The weathering reactivity correlates strongly with the percentage of Holocene area (r^2 = 0.9193; Fig. 1c), suggesting Holocene surface area distribution to be a good predictor for the enhanced alkalinity fluxes from a volcanic system:

$$F_{alkalinity} = (1 + 0.096 \times H) \times 0.2007 \times e^{(0.0692 \times T)} [10^6 mol\ km^{-2} a^{-1}] \quad \text{(eq. 4)}$$

$$F_{alkalinity} = (1 + 0.10 * H) * 0.23 * e^{(0.06*T)} [10^6\ mol\ km^{-2} a^{-1}], \text{ standard deviation} = 0.3 \quad \text{(eq.5)}$$

where H is the Holocene fraction of a volcanic system in % and T is land surface temperature in °C.

The Holocene fraction is not interpreted as the physical cause for elevated alkalinity fluxes. Instead, magmatic CO_2 contribution, geothermal-hydrothermal activity and the input of new volcanic material to the surface (properties and "freshness" of the surface area for reaction) are contributing to enhanced alkalinity fluxes.on top of the surface (properties and "freshness" of the surface area for reaction) are contributing to enhanced alkalinity fluxes. Volcanic ashes and ejecta might contribute to elevated weathering fluxes because of a relatively high content of glass. Glass dissolution rates are relatively high compared to mineral dissolution rates in general, but base cation content release varies dependent on the Si:O ratio (Wolff-Boenisch et al., 2006).

The magmatic CO_2 contributions to alkalinity fluxes in young volcanic systems may be large in general, but data are scarce to evaluate the global relevance for AVFs. For the Lesser Antilles a magmatic contribution of 23 to 40% to the CO_2 consumed by weathering was identified (Rivé et al., 2013). High ^{13}C-DIC values suggest that magmatic CO_2 contributes significantly to the alkalinity fluxes from the Virunga system (Balagizi et al., 2015). The magmatic CO_2 contribution derived from volcanic calcite dissolution on Iceland was estimated to be about 10% of the alkalinity fluxes for the studied area (Jacobson et al., 2015). In case of the Etna 7% of the CO_2 emitted due to volcanic activity may be captured by weathering (Aiuppa et al., 2000). These examples suggest that significant amounts of magmatic carbon may be transferred to the ocean directly via intra-volcanic weathering from AVFs.

These examples show that in case of active volcanic fields the traditional view on kinetic versus supply limitation in the “shallow” critical zone in context of tectonic settings does not hold (e.g., Ferrier et al., 2016). In contrary the supply of fresh material on top of the classical critical zone and the weathering from below the classical critical zone, suggests that these hot spots of silicate weathering in active volcanic areas, which contribute over proportionally to the global CO_2 consumption by silicate weathering, demand likely a different way of looking at it. The blue data points (IVF) in Figure 2d suggest a kinetic limited regime and follow a temperature dependency. The red points (AVF) however are located above the data points of IVF in general. Taking into account that the four AVFs Mt. Etna, Mt. Cameroon, Virunga and La Reunion have the highest Holocene fractions (96.6%-27.7%) and that the further AVFs, which have less than 15% Holocene coverage are located in general above the regression line for IVFs, supports the argument that a combination of elevated geothermal fluxes, magmatic CO_2 and fresh material supplied on top of the classical critical zone contribute to the observed elevated alkalinity fluxes for AVFs in general.

The calculated global basalt weathering alkalinity fluxes based on previous global models (Bluth and Kump, 1994; Amiotte-Suchet and Probst, 1995; Dessert et al., 2003; Goll et al., 2014~~; Suchet and Probst, 1995~~) give alkalinity fluxes ranging between 0.~~7~~8 to 1.~~6~~7 $\times 10^{12}$ mol a^{-1}. These values are different to previously published results based on the same models because a different geological map and climate data are used in this study. The new scaling law calculation based on the temperature dependence of weathering rate and the age dependence of weathering reactivity (eq. 4) results in higher global alkalinity fluxes of ~~2~~1.9$\times 10^{12}$ mol a^{-1} and 3.~~4~~3 $\times 10^{12}$ mol a^{-1} for regions with > 74mm a^{-1} runoff, and for all areas, respectively. The latter higher estimate is mainly due to the modeled contribution from dry and hot regions and shows that it is relevant to apply the runoff cut off.

Using the introduced new approach, considering the aging of a volcanic system, reveals that alkalinity fluxes from Holocene areas contribute today only ~~6~~5% to the global basalt weathering alkalinity flux. This is because so far identified mapped Holocene volcanic areas cover only ~1%

of all basalt areas. This study did not include areas of less mafic volcanic areas, like andesites, or middle American volcanics.

The Holocene area is probably underestimated due to information gaps in the reported age information of the global map. The strong dependence of weathering reactivity on relative age of the surface of a considered volcanic system suggests that it is relevant to know the global spatial age distribution of volcanic areas in more detail. Therefore, a new global review of the age distribution of basalt areas would be needed, which is beyond the scope of this study. The lithologies, predominantly described as basaltic in the global map, might introduce an additional bias to the global calculations because heterogeneities in the lithology cannot be excluded. Two active volcanic fields (Sao Miguel and Tianchi Lake) were excluded from the calculation of the scaling law function because available catchments with alkalinity data hold largely lithologies of trachytic composition. Nevertheless, their data points (Fig. 1c) seem to show the same weathering behavior.

Table 1: Summary of CO_2 consumption rates for global basaltic areas applying different models and the new parameterization. For simplicity it was assumed that alkalinity fluxes equal CO_2 consumption. The percentiles of the values of the global calculation by the new scaling law (Monte Carlo method) can be found in the supplement information. The standard deviation is represented by "New scaling law – std" as described in the SI.

		Global CO_2 consumption rate (10^9 mol/a) for limited area in comparison (only areas with > 74mm/a runoff)	Global CO_2 consumption rate (10^9 mol/a)
Dessert et al. 2003	runoff, temperature	1567	1573
Amiotte-Suchet & Probst, 1995	runoff	838	843
Bluth & Kump, 1994	runoff	739	754
Goll et al., 2014	runoff, temperature	1471	1477
New equation	temperature	1992	3431

Models for comparison	parameters	Global CO_2 consumption rate (10^9 mol/a) for limited area in comparison (only areas with > 74mm/a runoff)	Global CO_2 consumption rate (10^9 mol/a)
Dessert et al. 2003	runoff, temperature	1669	1684
Amiotte-Suchet & Probst, 1995	runoff	863	870

Bluth & Kump, 1994	runoff	746	761
Goll et al., 2014	runoff, temperature	1566	1580
New scaling law	temperature	1930	3300
New scaling law – std (SI)		90	200

The applied time ~~stamp~~period of the Holocene boundary suggests that the aging of the "weathering motor" of a basaltic volcanic area, including internal weathering, with declining volcanic activity is rather rapid. This implies that peaks in global volcanic activity have probably a short but intensive effect on the CO_2 consumption. A pronounced effect on the global carbon cycle by shifting the global reactivity of volcanic areas may only be relevant for geological periods with significantly elevated production of new volcanic areas, accompanied by geothermal-hydrothermal activity and capture of magmatic CO_2 before its escape to the atmosphere.

Results may have relevance for the carbon cycle and climate studies ~~considering~~exploring the ~~displacement~~emplacement of large igneous provinces like the CAMP (Schaller et al., 2012) or the Deccan traps ~~(Caldeira, 1990)~~(Caldeira and Rampino, 1990) with production of large basaltic areas within a short time. However, the biological contribution to CO_2 drawdown, via elevated fertilization effects, *e.g.* P- or Si-release due to weathering and elevated CO_2 in the atmosphere ~~must also~~should be taken into account, too.

Looking deeper into Earth's history: variations in the solid Earth CO_2 degassing rate or changes in environmental conditions affecting the weathering intensity (Teitler et al., 2014; Hartmann et al., 2017~~; Teitler et al., 2014~~) may have caused different reactivity patterns in dependence of surface age~~, if compared to the ones identified for the recent conditions~~ as shown here.

In conclusion, a simple approach to detect an aging effect, using surface age as a proxy for several combined processes, was chosen due to availability of data. It can be shown that there exists a linear relationship between temperature normalized alkalinity fluxes and the Holocene area fraction of a volcanic system. Nevertheless, the combined effect on elevated weathering reactivity due to magmatic CO_2 contribution, hydrothermal activity, production of fresh surface area for reaction, and hydrological factors of young volcanic systems remains to be disentangled, for single volcanic systems, as well as for the emplacement of larger, trap-style basalt areas.

Acknowledgements:

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6. References

~~Aiuppa, A. et al., 2000.~~Aiuppa, A., Allard, P., D'Alessandro, W., Michel, A., Parello, F., Treuil, M., and Valenza, M.: Mobility and fluxes of major, minor and trace metals during basalt weathering and groundwater transport at Mt. Etna volcano (Sicily~~).~~), Geochimica et Cosmochimica Acta, 64~~(11):~~, 1827-1841, 2000.

~~Balagizi, C.M. et al., 2015.~~Amiotte-Suchet, P., and Probst, J. L.: A global model for present-day atmospheric/soil CO2 consumption by chemical erosion of continental rocks (GEM-CO2), Tellus B, 47, 273-280, 10.1034/j.1600-0889.47.issue1.23.x, 1995.

Balagizi, C. M., Darchambeau, F., Bouillon, S., Yalire, M. M., Lambert, T., and Borges, A. V.: River geochemistry, chemical weathering, and atmospheric CO2 consumption rates in the Virunga Volcanic Province (East Africa~~).~~), Geochemistry, Geophysics, Geosystems, 16~~(8):~~, 2637-2660, 10.1002/2015GC005999, 2015.

Berner, R. A., Lasaga, A. C., and Garrels, R. M~~., 1983.~~.: The carbonate-silicate geochemical cycle and its effect on atmospheric carbon dioxide over the past 100 million years~~.~~, Am J Sci, 283~~:~~, 641-683, 1983.

Bluth, G. J., and Kump, L. R~~., 1994.~~.: Lithologic and climatologic controls of river chemistry~~.~~, Geochimica et Cosmochimica Acta, 58~~(10):~~, 2341-2359, 1994.

Caldeira, K., and Rampino, M. R~~., 1990.~~.: Carbon dioxide emissions from Deccan volcanism and a K/T boundary greenhouse effect~~.~~, Geophysical Research Letters, 17~~(9):~~, 1299-1302, 1990.

Cohen, K., Finney, S., Gibbard, P., and Fan, J.-X~~., 2013.~~.: The ICS international chronostratigraphic chart~~.~~, Episodes, 36~~(3):~~, 199-204, 2013.

Coogan, L. A., and Dosso, S. E~~., 2015.~~.: Alteration of ocean crust provides a strong temperature dependent feedback on the geological carbon cycle and is a primary driver of the Sr-isotopic composition of seawater~~.~~, Earth and Planetary Science Letters, 415~~:~~, 38-46, http://dx.doi.org/10.1016/j.epsl.2015.01.027, 2015.

~~Dessert, C. et al., 2001.~~Dessert, C., Dupré, B., François, L. M., Schott, J., Gaillardet, J., Chakrapani, G., and Bajpai, S.: Erosion of Deccan Traps determined by river geochemistry: impact on the global climate and the 87Sr/86Sr ratio of seawater~~.~~, Earth and Planetary Science Letters, 188~~(3–4):~~, 459-474, http://dx.doi.org/10.1016/S0012-821X(01)00317-X, 2001.

Dessert, C., Dupré, B., Gaillardet, J., François, L. M., and Allègre, C. J~~., 2003.~~.: Basalt weathering laws and the impact of basalt weathering on the global carbon cycle~~.~~, Chemical Geology, 202~~(3–4):~~, 257-273, http://dx.doi.org/10.1016/j.chemgeo.2002.10.001, 2003.

Fekete, B. M., Vörösmarty, C. J., and Grabs, W~~., 2002.~~.: High‐resolution fields of global runoff combining observed river discharge and simulated water balances~~.~~, Global Biogeochemical Cycles, 16~~(3).~~, 2002.

Ferrier, K. L., Riebe, C. S., and Jesse Hahm, W.: Testing for supply‐limited and kinetic‐limited chemical erosion in field measurements of regolith production and chemical depletion, Geochemistry, Geophysics, Geosystems, 17, 2270-2285, 2016.

Gaillardet, J., Dupré, B., Louvat, P., and Allègre, C. J~~., 1999.~~.: Global silicate weathering and CO2 consumption rates deduced from the chemistry of large rivers~~.~~, Chemical Geology, 159~~(1–4):~~, 3-30, http://dx.doi.org/10.1016/S0009-2541(99)00031-5, 1999.

Gaillardet, J~~. et al., 2011.~~., Rad, S., Rivé, K., Louvat, P., Gorge, C., Allègre, C. J., and Lajeunesse, E.: Orography-driven chemical denudation in the Lesser Antilles: Evidence for a new feed-back mechanism stabilizing atmospheric CO2~~.~~, American journal of science, 311~~(10):~~, 851-894, 2011.

Goddéris, Y~~. et al., 2003.~~., Donnadieu, Y., Nédélec, A., Dupré, B., Dessert, C., Grard, A., Ramstein, G., and François, L. M.: The Sturtian 'snowball' glaciation: fire and ice~~.~~, Earth and Planetary Science Letters, 211~~(1–2):~~, 1-12, http://dx.doi.org/10.1016/S0012-821X(03)00197-3, 2003.

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Goll, D. S., Moosdorf, N., Hartmann, J., and Brovkin, V~~., 2014.~~.: Climate-driven changes in chemical weathering and associated phosphorus release since 1850: Implications for the land carbon balance~~.~~, Geophysical Research Letters, 41~~(10):~~, 3553-3558, 10.1002/2014GL059471, 2014.

Hartmann, J., Jansen, N., Dürr, H. H., Kempe, S., and Köhler, P~~., 2009.~~.: Global CO2-consumption by chemical weathering: What is the contribution of highly active weathering regions~~?~~?, Global and Planetary Change, 69, 185-194, 2009.

~~Hartmann, J., Li, G., West, A.J., 2017. Running out of gas: Zircon 18O-Hf-U/Pb evidence for Snowball Earth preconditioned by low degassing. Geochemical Perspectives Letters, 4: 41-46.~~

~~Hartmann, J., Moosdorf, N., 2012.~~Hartmann, J., and Moosdorf, N.: The new global lithological map database GLiM: A representation of rock properties at the Earth surface~~.~~, Geochemistry, Geophysics, Geosystems, 13~~(12):~~, n/a-n/a, 10.1029/2012gc004370, 2012.

Hartmann, J., Li, G., and West, A. J.: Running out of gas: Zircon 18O-Hf-U/Pb evidence for Snowball Earth preconditioned by low degassing, Geochemical Perspectives Letters, 4, 41-46, http://dx.doi.org/10.7185/geochemlet.1734, 2017.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G., and Jarvis, A~~., 2005.~~.: Very high resolution interpolated climate surfaces for global land areas~~.~~, International journal of climatology, 25~~(15):~~, 1965-1978, 2005.

Jacobson, A. D., Grace Andrews, M., Lehn, G. O., and Holmden, C~~., 2015.~~.: Silicate versus carbonate weathering in Iceland: New insights from Ca isotopes~~.~~, Earth and Planetary Science Letters, 416~~:~~, 132-142, http://dx.doi.org/10.1016/j.epsl.2015.01.030, 2015.

Kent, D. V., and Muttoni, G~~., 2013.~~.: Modulation of Late Cretaceous and Cenozoic climate by variable drawdown of atmospheric ~~<i>p</i>CO₂~~pCO2 from weathering of basaltic provinces on continents drifting through the equatorial humid belt~~.~~, Clim. Past, 9~~(2):~~, 525-546, 10.5194/cp-9-525-2013, 2013.

Li, G., and Elderfield, H~~., 2013.~~.: Evolution of carbon cycle over the past 100 million years~~.~~, Geochimica et Cosmochimica Acta, 103~~:~~, 11-25, http://dx.doi.org/10.1016/j.gca.2012.10.014, 2013.

~~Li, G. et al., 2016.~~Li, G., Hartmann, J., Derry, L. A., West, A. J., You, C.-F., Long, X., Zhan, T., Li, L., Li, G., Qiu, W., Li, T., Liu, L., Chen, Y., Ji, J., Zhao, L., and Chen, J.: Temperature dependence of basalt weathering~~.~~, Earth and Planetary Science Letters, 443~~:~~, 59-69, http://dx.doi.org/10.1016/j.epsl.2016.03.015, 2016.

Rad, S., Rivé, K., Vittecoq, B., Cerdan, O., and Allègre, C. J~~., 2013.~~.: Chemical weathering and erosion rates in the Lesser Antilles: An overview in Guadeloupe, Martinique and Dominica~~.~~, Journal of South American Earth Sciences, 45~~:~~, 331-344, http://dx.doi.org/10.1016/j.jsames.2013.03.004, 2013.

Rivé, K., Gaillardet, J., Agrinier, P., and Rad, S~~., 2013.~~.: Carbon isotopes in the rivers from the Lesser Antilles: origin of the carbonic acid consumed by weathering reactions in the Lesser Antilles~~.~~, Earth Surface Processes and Landforms, 38~~(9):~~, 1020-1035, 10.1002/esp.3385, 2013.

Schaller, M. F., Wright, J. D., Kent, D. V., and Olsen, P. E~~., 2012.~~.: Rapid emplacement of the Central Atlantic Magmatic Province as a net sink for CO2~~.~~, Earth and Planetary Science Letters, 323–324~~:~~, 27-39, http://dx.doi.org/10.1016/j.epsl.2011.12.028, 2012.

~~Suchet, P.~~Taylor, A., ~~Probst~~and Blum, J.~~L., 1995. A global model for present-day atmospheric/~~ D.: Relation between soil ~~CO2 consumption by~~age and silicate weathering rates determined from the chemical ~~erosion~~evolution of ~~continental rocks (GEM-CO2). Tellus B, 47(1-2): 273-280.~~a glacial chronosequence, Geology, 23, 979-982, 1995.

Teitler, Y., Le Hir, G., Fluteau, F., Philippot, P., and Donnadieu, Y~~., 2014.~~.: Investigating the Paleoproterozoic glaciations with 3-D climate modeling~~.~~, Earth and Planetary Science Letters, 395~~:~~, 71-80, http://dx.doi.org/10.1016/j.epsl.2014.03.044, 2014.

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Walker, J. C. G., Hays, P. B., and Kasting, J. F., 1981..: A negative feedback mechanism for the long-term stabilization of Earth's surface temperature., Journal of Geophysical Research: Oceans, 86(C10):, 9776-9782, 10.1029/JC086iC10p09776, 1981.

Wolff-Boenisch, D., Gislason, S. R., and Oelkers, E. H.: The effect of crystallinity on dissolution rates and CO2 consumption capacity of silicates, Geochimica et Cosmochimica Acta, 70, 858-870, 2006.

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Supplementary Materials for

Short Communication: Supplement Information

Aging of basalt volcanic systems and decreasing CO_2 consumption by weathering

This supplementary material describesJanine Börker[1], Jens Hartmann[1], Gibran Romero-Mujalli[1], Gaojun Li[2]

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Supplemental Material A to G describe available information on the used volcanic, basalt dominated areas and the calculation procedures. For the active volcanic fields (AVF) a detailed description of the calculation for the fraction of the Holocene area fraction on the total area is given. Additionally, a description of the newnewly introduced alkalinity flux equationscaling law for young active basaltic areas and an explanation for the calculation of the global fluxes is provided.

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Part One

Supplemental Material A: Summary of data compilation as applied in the main text

Table S1: Summary of the data of IVFs and AVFs used for this study.

Supplemental Material B: New data for active volcanic fields as described in Table S1, in addition to Li et al. (2016)

Supplemental Material C: Saturation state with respect to calcite

Supplemental Material D: Additional relations between Alkalinity, Reactivity and Holocene area fraction

Supplemental Material E: Estimation of the parameters for the new scaling law

Supplemental Material F: Global calculations CO_2 consumption by basalt weathering

Supplemental Material G: Enhanced global basalt map beyond GLIM

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Supplemental Material A: Summary of data compilation as applied in the main text

Table S1: Summary of the data of Inactive Volcanic Fields (IVFs) and Active Volcanic Fields (AVFs) used for the analysis in the main text (Li et al., 2016), as well as calculated Holocene fraction and Reactivity R.

No.	Name	Volcanic activity	T (°C)	σ_T	Runoff (mm/yr)	σ_{Runoff}	Alkalinity (µmol/L)	$\sigma_{Alkalinity}$	Alkalinity flux rate (10^6 mol/km^2/yr)	$\sigma_{Alkalinity\ flux\ rate}$	Latitude (°)	Longitude (°)	Holocene fraction (%)	Calculated Reactivity R
1	Massif Central	Inactive	8.70	0.65	406	20	916	46	0.372	0.026	45.7700	2.9600	0	0.96
2	South Africa	Inactive	12.70	1.80	244	55	1728	1078	0.420	0.130	-25.2758	29.6324	0	
3	Karelia	Inactive	-2.00	1.00	285	20	460	41	0.131	0.007	65.0000	31.0000	0	
4	Coastal Deccan	Inactive	25.10	0.50	1690	150	657	17	1.110	0.103	16.9300	73.5100	0	
5	Interior Deccan	Inactive	25.40	0.50	401	48	2839	170	1.138	0.152	21.0000	74.0000	0	
6	Siberia Traps	Inactive	-8.50	0.65	254	25	501	89	0.127	0.019	65.0000	100.0000	0	
7	E'Mei	Inactive	6.20	1.00	1350	75	238	23	0.321	0.036	27.4462	103.3255	0	
8	Lei-Qiong	Inactive	24.00	1.00	797	100	1923	165	1.532	0.233	20.4600	110.1800	0	
9	Nanjing	Inactive	15.20	1.00	330	48	1595	63	0.526	0.079	32.7400	118.3900	0	
10	Xiaoxinganling	Inactive	-1.00	1.00	243	50	1065	132	0.259	0.062	49.0942	128.1704	0	
11	Tumen River	Inactive	-4.00	2.00	273	50	763	50	0.208	0.041	42.5000	128.5000	0	
12	Mudan River	Inactive	3.20	2.00	209	46	977	87	0.204	0.048	43.7500	128.7200	0	

13	SE Australia	Inactive	13.~~0~~00	0.10	74	14	5956	657	0.441	0.097	-38.~~19~~1883	142.~~86~~8587	0~~.00~~
14	Tasmania	Inactive	10.~~1~~10	0.25	221	30	1704	437	0.377	0.109	-42.~~19~~1900	146.~~76~~7600	0~~.00~~
15	North Island~~, NZ~~	Inactive	13.~~0~~00	2.00	920	161	478	131	0.439	0.143	-38.~~00~~0000	176.~~00~~0000	0~~.00~~
16	Kauai, Hawaii	Inactive	21.~~6~~58	0.65	1747	539	588	251	1.026	0.303	22.~~00~~0000	-159.~~50~~5000	0~~.00~~
17	Columbia Plateau	Inactive	7.~~4~~40	2.00	204	191	927	215	0.189	0.060	44.~~00~~0000	-118.~~50~~5000	0~~.00~~
18	NE America	Inactive	0.~~7~~70	2.30	507	129	465	316	0.235	0.075	47.~~05~~0483	-75.~~32~~3229	0~~.00~~
19	Madeira Island	Inactive	13.~~5~~50	1.50	1065	100	580	43	0.618	0.074	32.~~80~~8000	-17.~~00~~0000	0~~.00~~
20	Easter Island	Active	20.~~6~~60	1.00	580	100	1306	132	0.757	0.151	-27.~~12~~1200	-109.~~37~~3700	3.36
21	Mt. Cameroon	Active	14.~~0~~00	2.00	2120	500	2368	110	5.020	1.207	4.~~00~~0000	9.~~00~~0000	96.57
22	Mt. Etna	Active	14.~~9~~90	0.20	640	80	9286	539	5.943	0.819	37.~~75~~7514	~~15.00~~14.9974	79.56
23	Virunga	Active	20.~~8~~80	1.30	1709	380	2646	~~-1.50~~1757	4.522	2.110	-1.5000	29.~~50~~5000	~~48.02~~47.95
24	La Réunion	Active	17.~~0~~00	2.00	1712	652	1243	290	2.127	0.031	-21.~~12~~1200	55.~~54~~5400	~~28.13~~27.73
25	Wudalianchi Lake	Active	-1.~~0~~00	1.00	243	50	1919	190	0.466	0.106	48.~~70~~7010	126.~~14~~1411	14.82

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26	Japan	Active	~~11.0~~10.99	1.12	1236	64	584	73	0.722	0.107	35.~~92~~9234	135.~~36~~3560	8.~~70~~7	
27	Kamchatka	Active	-3.~~5~~50	2.00	520	50	854	100	0.444	0.067	55.~~00~~0000	159.~~00~~0000	2.28	
28	Taranaki	Active	10.~~0~~00	3.00	1296	223	667	34	0.864	0.155	-39.~~30~~3000	174.~~00~~0000	8.~~00~~	
29	Big Island, Hawaii	Active	15.~~4~~44	2.00	935	269	951	424	0.889	0.303	19.~~50~~5000	-155.~~50~~5000	~~13.73~~14.08	
30	High Cascades	Active	6.~~8~~81	0.47	382	172	776	175	0.296	0.108	45.~~19~~1924	-121.~~68~~6844	0.~~20~~2	
31	Iceland~~São Miguel~~	Active	~~16.~~0.70	~~879~~0.65	1734~~2331~~	~~37.77~~136	~~-25.50~~498	74~~9.35~~	0.864	0.109	65.0000	-18.0000	13.19	
32	Sao Miguel~~Iceland~~	Active	~~0.7~~16.00	1.00~~1734~~	~~498~~879	~~65.00~~50	2331~~-18.00~~	~~13.19~~200	~~4.11~~2.047	0.211	37.7700	-25.5000	9.35	
33	Tianchi Lake	Active	-7.~~3~~30	2.00	291*	100	2445	300	0.711	0.260	42.~~00~~0000	128.~~05~~0500	65.34	

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*The runoff for Tianchi Lake was recalculated after Fekete et al. (2002).

Supplemental Material B: New data for active volcanic fields as described in Table S1, in addition to (Li et al., 2016)

In the following, all active volcanic provinces used for this study are described. Note, that for all inactive fields a detailed description of the input data can be found in Li et al. (2016), as well as the origin of the temperature, runoff and alkalinity/DIC concentration data for active and inactive volcanic fields. If watersheds are considered for the calculations of the Holocene area, they are based on the locations of the sampling points (see Li et al. (2016)).

In the following, the new data for active volcanic fields are described (Table S1)

For the calculation of the Holocene fraction area for each volcanic field we used several time spans. A polygon with an age description of Holocene (0-11.7 ka) was classified as a “Holocene”-area. If a polygon had an age description which laid in the time interval of 0 to 2.58 Ma, but it was not clearly defined as of Holocene or Pleistocene age, we defined it as “Quaternary” and applied a theoretical Holocene fraction by the ratio of Holocene time span and Quaternary time span. All other polygons with age descriptions older than Holocene and not defined as “Quaternary” were defined as “Non-Holocene”.

Numbers behind a region indicate the number in the summary table S1.

Easter Island (No.20)

Easter Island is a volcanic island in the eastern pacific. Its volcanic nature is related to the Easter Island Hotspot. The geologic map used for this study was digitized after a map of Gioncada et al. (2010) and references therein. The island is composed mostly of hawaiites, mugearites and olivine basalts and it comprises volcanic ages from 3 Ma to recent. The different age classifications and lithologies are listed in the table below. Due to the precise age information the rocks ~~could be~~are directly classified into Holocene rocks and non-Holocene rocks. The total basaltic area of the island is 162.~~28~~27 km^2, the Holocene area 5.45 km^2 and the non-Holocene area 156.82 km^2, resulting in a Holocene area fraction of 3.36%.

Table S2: Classification of the map data of Easter Island. The first three columns provide the original map data, whereas the column "System/Series" shows our interpretation of the map data.

Name	Description	Age	System/Series
TE1	Terevaka, hawaiites and olivine basalts	0.3-1.9~~-0.3~~ Ma	non-Holocene
TE2	Terevaka, hawaiites and olivine basalts	0.3-1.9~~-0.3~~ Ma	non-Holocene
TE3	Terevaka, hawaiites and olivine basalts	0.3-1.9~~-0.3~~ Ma	non-Holocene
HH2	Anakena, Hiva-Hiva, hawaiites and olivine basalts	0-~~2000a~~2,000 a ago	Holocene
RA1	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA5	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA4	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA2	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA8	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA7	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA6	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
RA3	Rano Aroi, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene

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HH1	Anakena, Hiva-Hiva, hawaiites and olivine basalts	0-~~2000a~~2,000 a ago	Holocene
PO2	Polke, alkali basalts, hawaiites to mugearites	~~3-~~0.61-3 Ma	non-Holocene
PO1	Polke, alkali basalts, hawaiites to mugearites	~~3-~~0.61-3 Ma	non-Holocene
PO5	Polke, alkali basalts, hawaiites to mugearites	~~3-~~0.61-3 Ma	non-Holocene
PO4	Polke, alkali basalts, hawaiites to mugearites	~~3-~~0.61-3 Ma	non-Holocene
TR	Maunga Orito, rhyolite; Maunga Parehe, trachyte	not known	not considered
PO3	Polke, alkali basalts, hawaiites to mugearites	~~3-~~0.61-3 Ma	non-Holocene
RK1	Rano Kau, alkali basalts, hawaiites to benmoreites	0.2-2.5~~-0.2~~ Ma	non-Holocene
RK2	Rano Kau, alkali basalts, hawaiites to benmoreites	0.2-2.5~~-0.2~~ Ma	non-Holocene
TA4	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA1	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA2	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA6	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA3	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA5	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene
TA7	Tangaroa, hawaiites, olivine basalts and mugearites	0.2 Ma	non-Holocene

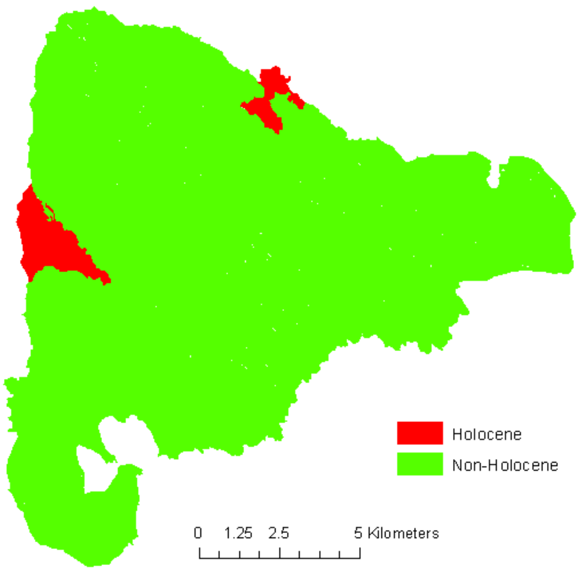

Figure S1: Map of Easter Island showing the Holocene and non-Holocene areas.

Table S3: Calculated areas for Easter Island. The Holocene fraction is derived by the ratio of Holocene area/Total area.

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
5.45	156.~~83~~82	0	162.~~28~~27	3.36

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Mount Cameroon (No.21)

Mount Cameroon is part of a volcanic chain at the coast of West Africa. The geological map was digitized from Le Maréchal (1975). ~~The classification of the individual lithologies~~The location of the sampling points were derived from Benedetti et al. (2003). The age classification (see table below) results in a Holocene fraction of 96.57%.

Table S4: Classification of the ~~lithologies~~surface ages of Mt. Cameroon. Note that the first three columns display the original map data, the column "System/Series" provides the authors interpretation.

Name	Description	Age	System/Series
beta1	Séries inférieures: basaltes parfois andésitiques sous forme de coulées et de dykes	Oligocene-Eocene	non-Holocene
beta3	Séries supérieures: basaltes parfois andésitiques sous forme de coulées et cinérites	quatenaire récente	Holocene

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The interpretation of the ages of Mount Cameroon was difficult, since the ages are not well determined (Ateba et al., 2009). Le Maréchal (1976) describes the ages of the basalts, as well as an unpublished map in Ateba et al. (2009) that shows "young basalts" in the center of Mount Cameroon so that we assumed an age of "recent quaternary" for "beta3".

Table S5: Area calculation of Mt. ~~Cameroon~~Cameroon. The Holocene fraction is derived by the ratio of Holocene area/Total area.

Area Holocene (km^2)	Area non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
~~1112~~1,112.63	39.48	0	~~1152~~1,152.11	96.57

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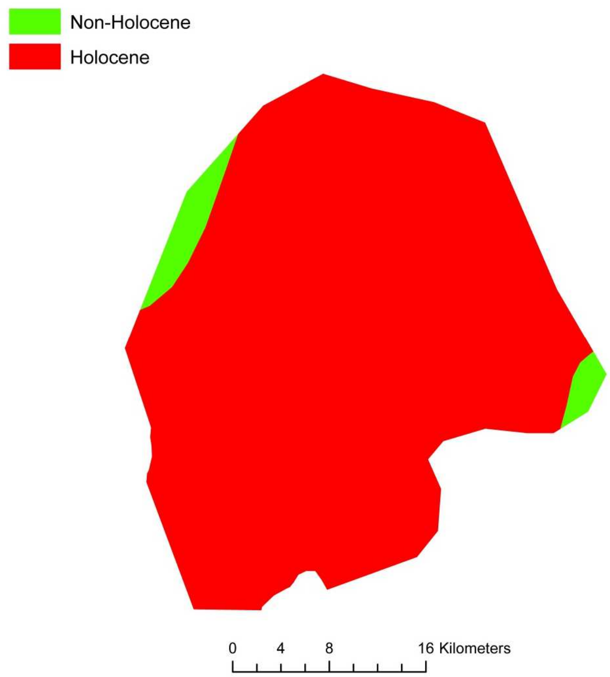

Figure S2: Map of Mount Cameroon showing the Holocene and non-Holocene area.

~~**Mount Etna (No.22)**~~

~~Mount Etna is located at a subduction zone in Italy. Its geological map was digitized from Branca et al. (2011). The detailed description of the lithologies can be seen below and provides a classification into Holocene, non-Holocene and Quaternary.~~

Mount Etna (No.22)

Mount Etna is located at a subduction zone in Italy. Its geological map was digitized from Branca et al. (2011a) and is described in Branca et al. (2011b). The detailed description of the lithologies is shown below and allows for a classification into Holocene, non-Holocene and Quaternary.

The Quaternary rocks are of an age of ~~15ka~~3.9 ka to ~~3.9ka~~15 ka, so that they have a time span of 11.~~1ka. Considering~~1 ka. 7.8 ka are within the Holocene period (3.9 ka to 11.7 ka) considering the Holocene time period going from 0 to 11.7 ka~~ the amount~~. The fraction of Holocene coverage ~~can be~~was than calculated by:

~~Holocene fraction = (Area Holocene + (Area Quaternary x (7.8ka / 11.1ka))) / Total Area~~

$$Holocene\ fraction = \frac{Area\ Holocene + \left(Area\ Quaternary * \left(\frac{7.8}{11.1}\right)\right)}{Total\ Area}$$

resulting in a Holocene fraction area of 79.56%.

Table S6: Classification of Etna basaltic rocks showing the original map data (first four columns) and our interpretation of the data ("System/Series").

Symbol	Name	Description	Age	System/Series
26u	lava flows, cinder cones and bastions, and fall deposits	basaltic to benmoreitic	~~4ka -~~ 122 b.C. – 4 ka	Holocene
27-1	Castings, cinder cones and bastions, and fall deposits	basaltic to mugearitica	1669 - 122 b.C. ~~- 1669~~	Holocene
27-2	Castings, cinder cones and bastions, and fall deposits	basaltic to mugearitica	1971 - 1669~~-1971~~	Holocene
27-3	Lava flows, cinder cones and bastions, and fall deposits	basaltic to mugearitica	~~1971-~~ current - 1971	Holocene
CB26u	Cono e bastione di scorie			Holocene
CB27-1	Cono e bastione di scorie			Holocene
CB27-2	Cono e bastione di scorie			Holocene
CB27-3	Cono e bastione di scorie			Holocene

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10a	: intercalated flows in a powerful pyroclastic flow deposit	mugearitica	nn	non-Holocene
14	Succession of alternating flows in pyroclastic deposits	hawaiitica to mugearitica	nn	non-Holocene
15	flows intercalated with clastic deposits	mugearitica to benmoreitic	nn	non-Holocene
17	Casting interbedded with clastic deposits	benmoreite	nn	non-Holocene
18	flows	mugearitica-benmoreitic	nn	non-Holocene
18a	bodies subvulcanici materials come from lavas	mugearitica-benmoreitic	nn	non-Holocene
1a	bodies subvolcanici		nn	non-Holocene
21b	porfirichi flows	hawaiitica to mugearitica	nn	non-Holocene
22b	casting succession	hawaiitica	nn	non-Holocene
24	of breccia autoclastic often altered to hydrothermalism, associated with lava flows	benmoreitic	nn	non-Holocene
26b	deposit of debris avalanche monogenic, formed by lava mugearitica blocks	nn	nn	Quaternary
3b	massive lava flows	basaltic	nn	non-Holocene
1	underwater transitional composition of volcanics in tholeiitica consist of pillow lavas	tholeiitica	496.1 - 542.2- 496.1ka ka	non-Holocene
10b	flows intercalated with breccias autoclastic and deposits epiclastici	hawaiitica to mugearitica	101.9ka	non-Holocene
11	Brecce autoclastic and deposits epiclastici	benmoreitic	99.1 - 107.2- 99.1ka ka	non-Holocene
12	deposits associated with pyroclastic flows	mainly mugearitica	99.9 - 101.8- 99.9ka ka	non-Holocene
13	castings and slag deposits	hawaiitica	93.0ka0 ka	non-Holocene
14a	subvulcanici bodies formed by lava massive	mugearitica	85.3ka3 ka	non-Holocene
16	: Casting intercalated with thin epiclastici deposits	mugearitica to benmoreitic	85.6ka6 ka	non-Holocene
19	Thin flows to the base, followed by a thick succession pyroclastic	mugeraitica	70.2 - 79.6- 70.2ka ka	non-Holocene
2	lava flows	tholeiitica	332.4ka4 ka	non-Holocene

20	Fall and pyroclastic flow deposits	hawaiitica to benmoreitic	41.3 - 56.6~~-~~ ~~41.3ka~~ ka	non-Holocene
21a	massive flows and autoclastic interbedded with breccia deposits	hawaiitica to mugearitica	29.1-32.~~5ka~~5 ka	non-Holocene
22	castings, scoria cones and fall deposits	hawaiitica to benmoreitic	28.7-42.~~1ka~~1 ka	non-Holocene
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
~~22~~	~~castings, scoria cones and fall deposits~~	~~hawaiitica to benmoreitic~~	~~28.7-42.1ka~~	~~non-Holocene~~
25b	reomorfiche flows	benmoreitic	15.0 - 15.4~~-~~ ~~15.0ka~~ ka	non-Holocene
2a	subvolcanico body structure		320.~~0ka~~0 ka	non-Holocene
3a	strongly altered lava flows	basaltic	180.~~2ka~~2 ka	non-Holocene
4a	massive lava flows	basaltic to mugearitica	129.9 - 154.9~~-~~ ~~129.9ka~~ ka	non-Holocene
4b	thin lava flows	basaltic to mugearitica	134.~~2ka~~2 ka	non-Holocene
6	Lave cataclasate	basaltic to mugearitica	128.~~7ka~~7 ka	non-Holocene
7	Succession Lava	mugearitica	126.~~4ka~~4 ka	non-Holocene
8	Succession lava with thin interbedded deposits epiclastici	hawaiitica to mugearitica	111.9 - 121.2~~-~~ ~~111.9ka~~ ka	non-Holocene
9	lava flows interbedded with massive deposits of local epiclastici	hawaiitica to benmoreitic	105.~~8ka~~8 ka	non-Holocene
CB2	Cono e bastione di scorie			non-Holocene
CB22	Cono e bastione di scorie			non-Holocene
CB3a	Cono e bastione di scorie			non-Holocene
CB7	Cono e bastione di scorie			non-Holocene

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26l	lava flows, cinder cones and bastions, and fall deposits	basaltic to benmoreitic	4 - 15ka - 4 ka	Quaternary
CB26l	Cono e bastione di scorie			Quaternary

Table S7: Table showing the calculated areas for Mount Etna. Note that the Holocene fraction is calculated by the above mentioned equation considering Holocene area, Quaternary area and total area.

Area Holocene (km^2)	**Area non-Holocene (km^2)**	**Area Quaternary (km^2)**	**Total Area (km^2)**	**Holocene (%)**
636.16	123.90	338.39	1098.461,098.45	79.56

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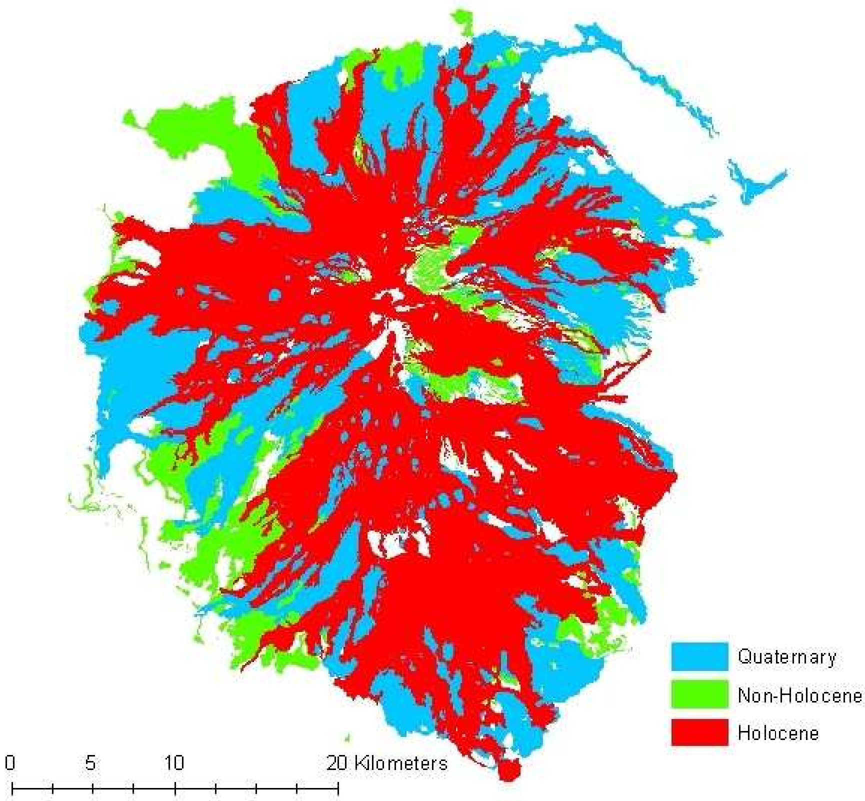
Quaternary
Non-Holocene
Holocene
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5
10
20 Kilometers

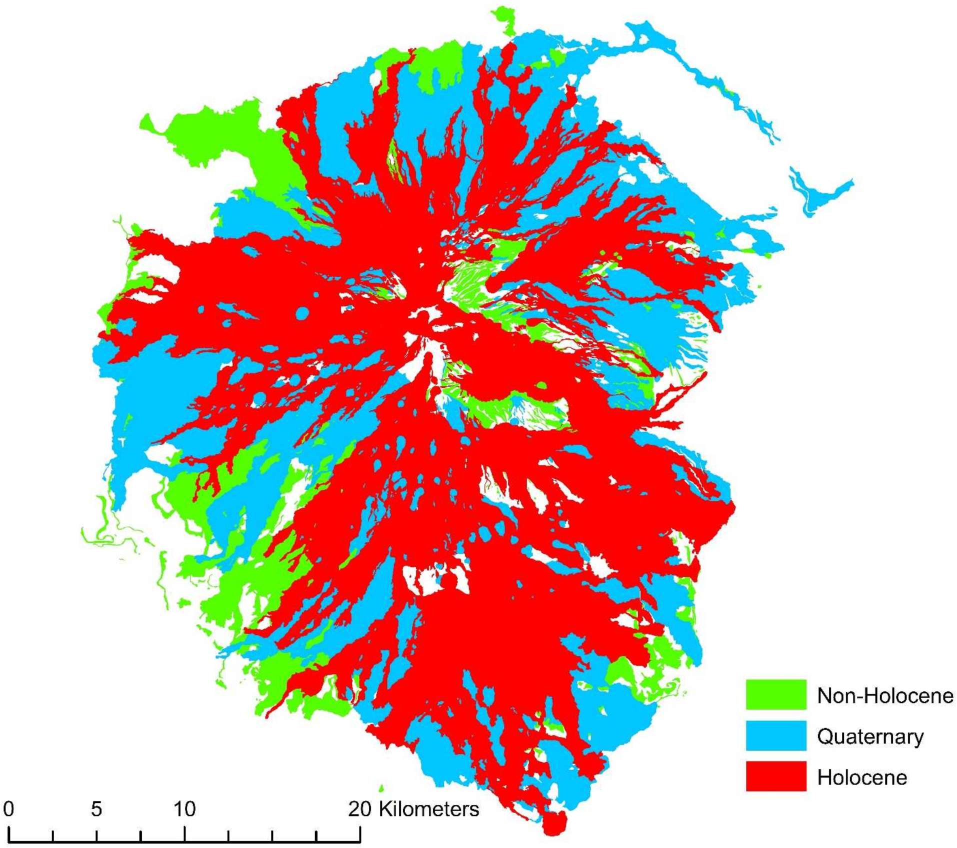

Figure S3: Map of Etna volcano showing the age distribution of basaltic rocks.

Virunga (No.23)

The Virunga Volcanic province is located in eastern central Africa and is related to the East African Rift system. The geologic map of this area was compiled ~~out of~~from four different maps ~~from Smets et al. (2010)~~published by Antun et al. (1971), ~~Balagizi et al. (2015)~~De Mulder et al. (1986), ~~Petricec et al. (1971)~~Smets et al. (2010) and ~~De Mulder~~Balagizi et al. (~~1986~~2015).

~~The western part of the province is classified as purely Holocene, whereas the volcanic rocks become older to the east. Considering the Quaternary age period ranging from 0 to 2.58Ma, the Holocene percentage of the Quaternary area is calculated by the ratio of 11700a/2580000a. The total theoretical Holocene areal percentage is 48.02% using:~~

~~Holocene fraction = (Area Holocene + (Area Quaternary x (11700a / 2580000a))) / Total Area~~

We assume that the volcanic areas of Nyiragongo and Nyamuragira are of Holocene age, since they are classified as Africa's most active volcanoes, and erupted frequently in the past (Smets et al., 2010; Balagizi et al., 2015). The remaining volcanoes are assumed to be of quaternary age (not older than Pleistocene (Antun et al., 1971). For the northeastern part of the map the surface age could not be determined clearly, and was therefore defined as "not known", and included in the calculations as "non-Holocene".

Considering that the Quaternary age period ranges from 0 to 2.58 Ma, the Holocene percentage of the Quaternary area is calculated by the ratio of 11,700 a / 2,580,000 a. The total theoretical Holocene areal percentage is 47.95% using:

$$Holocene\ fraction = \frac{Area\ Holocene + \left(Area\ Quaternary * \left(\frac{11,700}{2,580,000}\right)\right)}{Total\ area}$$

Table S8: Classification of basaltic rocks in the Virunga province showing the individual volcanoes and our interpretation of their age.

Id	Volcano	System/Series
0	Nyiragongo	Holocene
1	Nyamuragira	Holocene
2	Muhabura	~~Pleistocene~~Quaternary
3	Gahinga	Quaternary~~Pleistocene~~
4	~~Muhabura-Gahinga~~Synabaye	Quaternary~~Pleistocene~~
5	Bisoke-Sabinyo	Quaternary~~Pleistocene~~
6	Bisoke-Sabinyo~~-Gahinga~~	~~Pleistocene~~Quaternary
7	Bisoke-Sabinyo	Quaternary
8	Karisimbi	Quaternary

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9	Remaining areas	~~Quaternary~~Not known

Table S9: Calculated areas for Virunga province. The Holocene fraction is derived by applying the above mentioned equation considering the Holocene area, Quaternary area and total area.

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
~~1518~~1,518.62	~~320.69~~791.26	~~1335.72~~865.16	~~3175.03~~3,175.04	~~48.02~~47.95

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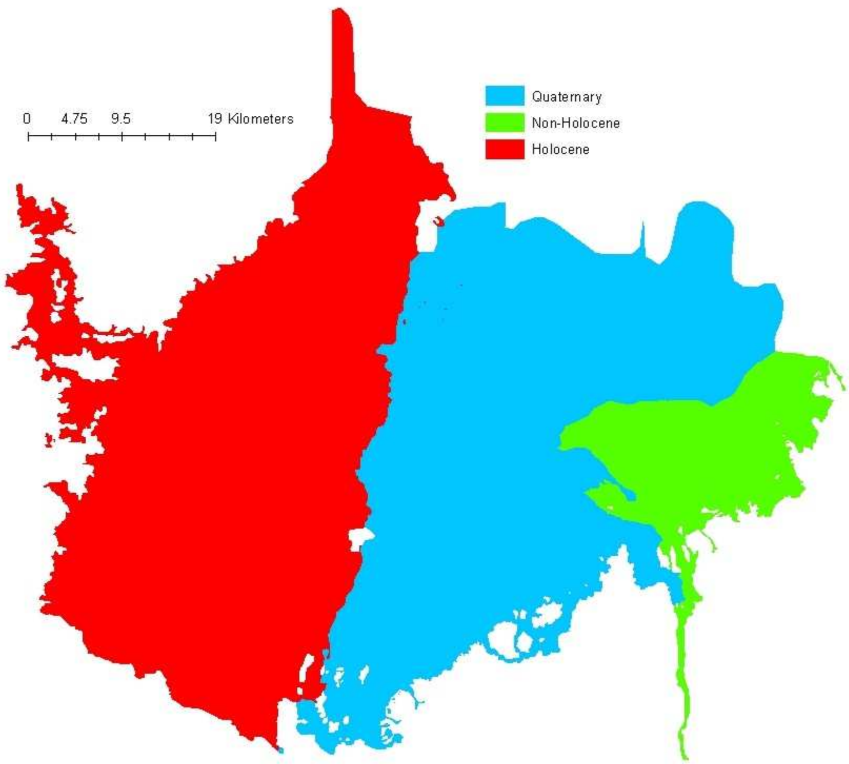

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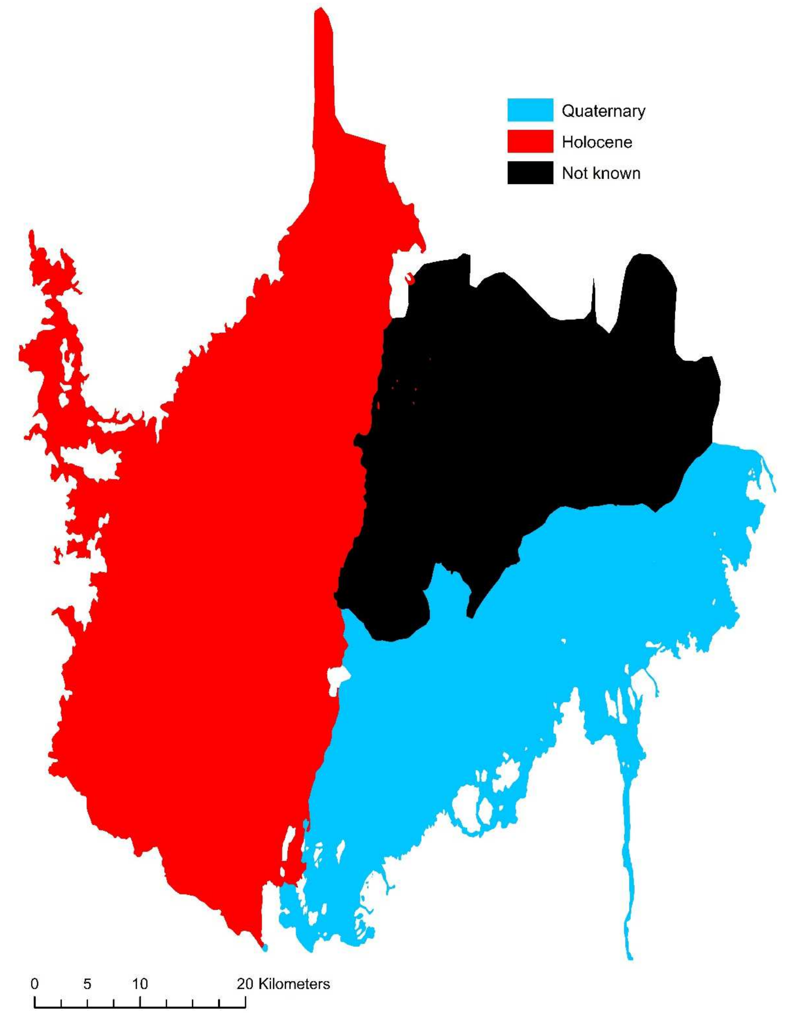

Figure S4: Map of the Virunga province showing the different areas of basalt classified after age.

La Réunion (No.24)

The volcanic island La Réunion belongs to a Hot Spot in the Indian Ocean and is comprised of Holocene, ~~non-Holocene and Quaternary volcanic rocks. The geological map was digitized from Nehlig et al. (2006). The rocks can be divided into Holocene, non-Holocene and two different types of Quaternary rocks (Qu1, Qu2):~~Quaternary and older volcanic rocks. The geological map was digitized from Nehlig et al. (2006). The watershed area considered for this study is derived from Louvat and Allègre (1997). The rocks are divided into Holocene, non-Holocene and two different types of Quaternary rocks (Qu1, Qu2).

Qu1~~: <340ka → ~~ is described as being younger than 340 ka which results in a theoretical Holocene fraction ~~=~~of 11.~~7ka/340ka~~7 ka / 340 ka.

~~Qu2: 65ka – 5ka → Holocene fraction = 6.7ka/60ka~~

The age of Qu2 ranges from 5 ka to 65 ka, providing a time span of 60 ka. 6.7 ka lay within the Holocene time span (11.7 ka – 5 ka), so that the Holocene fraction can be calculated by the ratio of 6.7 ka / 60 ka.

Thus, the total Holocene fraction ~~can be derived~~is calculated by:

~~Holocene fraction = (Area Holocene + (Area Qu1 x (11.7ka / 340ka)) + (Area Qu2 x (6.7ka / 60ka))) / Total Area~~

$$Holocene\ fraction = \frac{\left(Area\ Holocene + \left(Area\ Qu1 * \left(\frac{11.7}{340}\right)\right) + \left(Area\ Qu2 * \left(\frac{6.7}{60}\right)\right)\right)}{Total\ area}$$

providing a value of 28.13%.

Table S10: Classification of the basaltic rocks of La Réunion with the original data (first three columns) and our interpretation ("System/Series"). Note that "nn" represents that the age of the lithology is not known.

ID	Definition	Type	System/Series
beta 4	Coulées basaltiques	Massif du Piton de La Fournaise - Série du ~~bouclier~~bouclier ancien (~~450000~~450,000 à ~~150000~~150,000 ans)	non-Holocene
tfp	Pitons et projections	Massif du Piton de La Fournaise	nn
beta 7	Coulées basaltiques	Massif du Piton de La Fournaise - Série de la Plaine des Cafres (~~6500~~65,000 à ~~5000~~5,000 ans)	Quaternary2

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beta 6	Coulées basaltiques	Massif du Piton de La Fournaise - Série Plaine des Sables (~~65000~~65,000 à ~~5000~~5,000 ans)	Quaternary2
beta 8	Coulées basaltiques	Massif du Piton de La Fournaise - Série volcanique subactuelle (<~~5000~~5,000 ans)	Holocene
beta 5	Coulées basaltiques	Massif du Piton de La Fournaise - Série des Remparts (~~150000~~150,000 à ~~65000~~65,000 ans)	non-Holocene
beta 3	Coulées différenccié es	Massif du Piton de La Fournaise - Série alcaline anté-Fournaise (~~530000~~530,000 à ~~450000~~450,000 ans)	~~non-Holocene~~Not considered
beta 8e	Coulées basaltiques dans l'Enclos	Massif du Piton de La Fournaise - Série volcanique subactuelle (<~~5000~~5,000 ans)	Holocene
beta 1	Coulées basaltiques à olivine	Massif du Piton des Neiges - Série des océanites (>~~340000~~340,000 ans)	non-Holocene
beta 2	Coulées (basalte, hawaites, mugéarites)	Massif du Piton des Neiges - Série différenciée (<~~340000~~340,000 ans)	Quaternary1
Br	Brèches d'avalanche s de débris de Saint Gilles	Massif du Piton des Neiges - Série différenciée (<~~340000~~340,000 ans)	Quaternary1
pc	Coulées ignimbritiqu es	Massif du Piton des Neiges - Série différenciée (<~~340000~~340,000 ans)	Quaternary1
Tau	Coulées trachytiques du plateau de Belouve	Massif du Piton des Neiges - Série différenciée (<~~340000~~340,000 ans)	~~Quaternary1~~not considered

Table S11: Summary of calculated areas of La Réunion. Note that "tfp" is considered as of non-Holocene age. The Holocene fraction is calculated by the above mentioned equation considering Holocene area, Qu1 area, Qu2 area and the total area.

Area Holocene (km²)	Area non-Holocene (km²)	Area Qu1~~Quaternary~~ (km²)	Area Qu2 (km²)	Total Area (km²)	Holocene (%)
208.11	~~270.98~~285.29	~~359.60~~157.71	~~838.68~~199.37	~~28.13~~850.48	27.73

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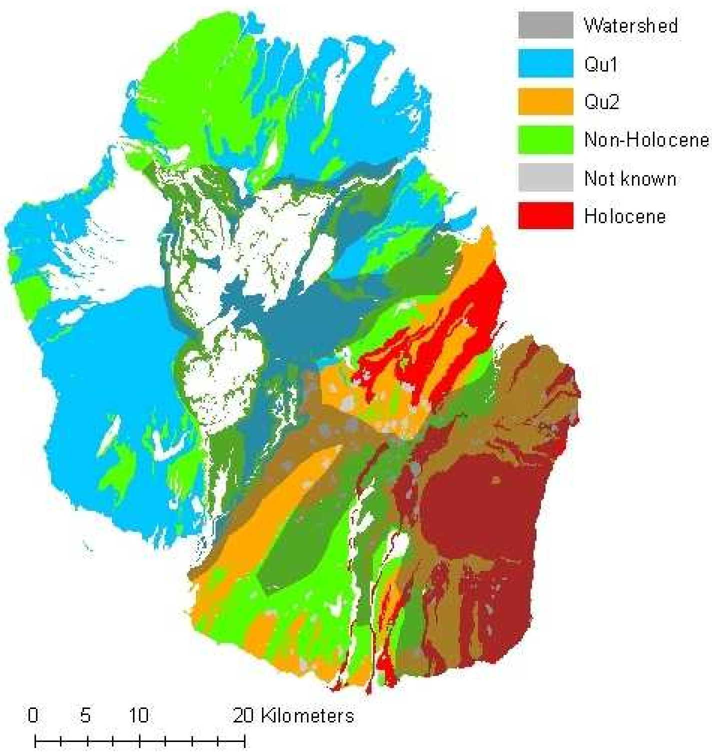
Watershed
Qu1
Qu2
Non-Holocene
Not known
Holocene
0 5 10 20 Kilometers

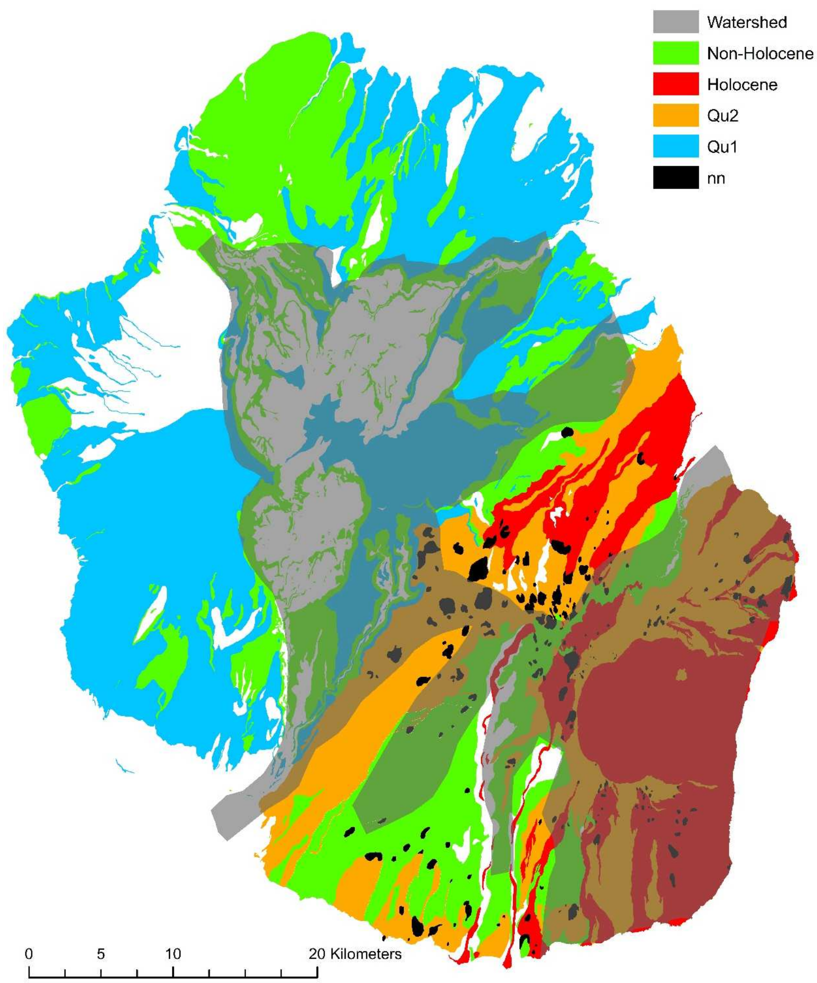

Figure S5: Map of La Réunion showing the basaltic ages and additionally the watershed of the water samples. Only the watershed area was considered for this study.

Wudalianchi Lake (No.25)

The basaltic rocks of Wudalianchi Lake are located in NE China and are of intraplate volcanic origin. The Geomap of Wudalianchi region was digitized after a map of the Ministry of Land and Resources of PRC, 2003 (unpublished work). The basalts ~~can be separated into~~are of Holocene and non-Holocene ~~and thus provide a calculated~~age. The Holocene fraction ~~of~~is 14.82%.

Table S12: Classification of ~~basalt~~basalts of Wudalianchi Lake with the original map data (first three columns) and our interpretation shown in the column "System/Series".

Symbol	Litho	Age	System/Series
betaQ2w	basalt	middle pleistocene	non-Holocene
betaQ1j	basalt	lower pleistocene	non-Holocene
betaQ2b	basalt	middle pleistocene	non-Holocene
betaQ1g	basalt	tertiary	non-Holocene
betaQ42l	basalt	holocene	Holocene

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Table S13: Calculated areas of Wudalianchi Lake. The Holocene fraction is calculated by Holocene area/total area.

Area Holocene (km^2)	Area non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
69.68	400.35	0	470.~~04~~03	14.82

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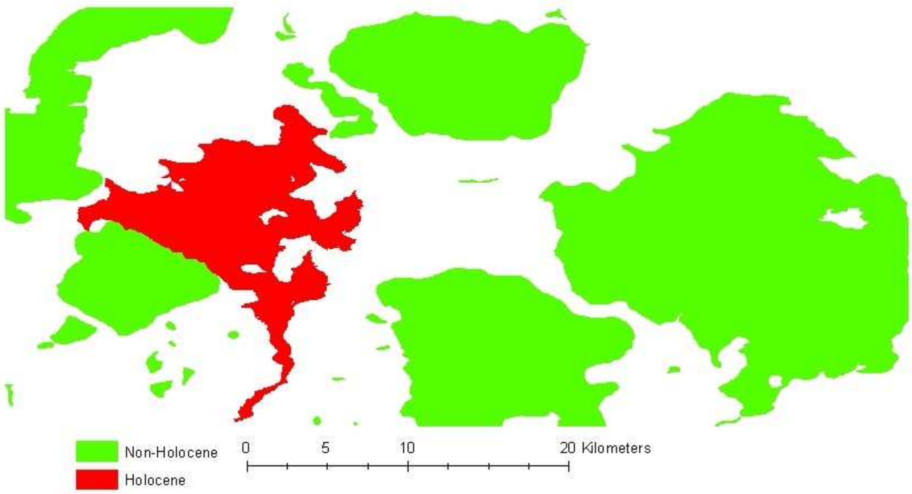

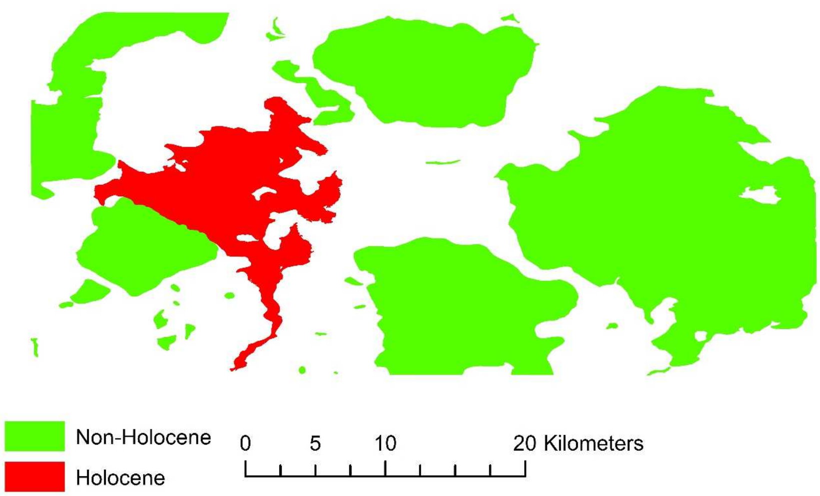

Figure S6: Map of Wudalianchi Lake showing the distribution of Holocene and non-Holocene basaltic rocks.

Japan (No.26)

The geological data was ~~derived of~~taken from the Global Lithological Map (GLiM) by Hartmann and Moosdorf (2012)~~ but only the ~~. Only watersheds of sample locations from the GLORICH database (Hartmann et al., 2014) were used~~, thus the~~. The basaltic rocks ~~can be divided~~(attribute xx = 'vb' in the GLiM) are classified into Holocene, non-Holocene and Quaternary rocks. The calculation procedure of the Holocene fraction of Quaternary rocks is the same as for the Virunga Province~~,~~ (No.23), and a final Holocene percentage of 8.70% is calculated.

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Table S14: Classification of basaltic rocks for Japan after the GLiM (first three columns) and our interpretation "System/Series".

xx	Age_Min	Age_Max	System/Series
vb	Holocene	Holocene	Holocene
vb	Neogene	Neogene	non-Holocene
vb	Paleogene	Paleogene	non-Holocene
vb	Paleozoic	Proterozoic	non-Holocene
vb	Pleistocene	Pleistocene	non-Holocene
vb	Pliocene	Pliocene	non-Holocene
vb	Quaternary	Quaternary	Quaternary

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Table S15: Calculated areas for ~~Japan~~the basaltic watersheds in Japan. Note that the Holocene fraction is calculated considering Holocene area, Quaternary area and total area.

Area Holocene (km^2)	Area non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
243.30	~~2216~~2,216.41	354.44	~~2814~~2,814.15	8.70

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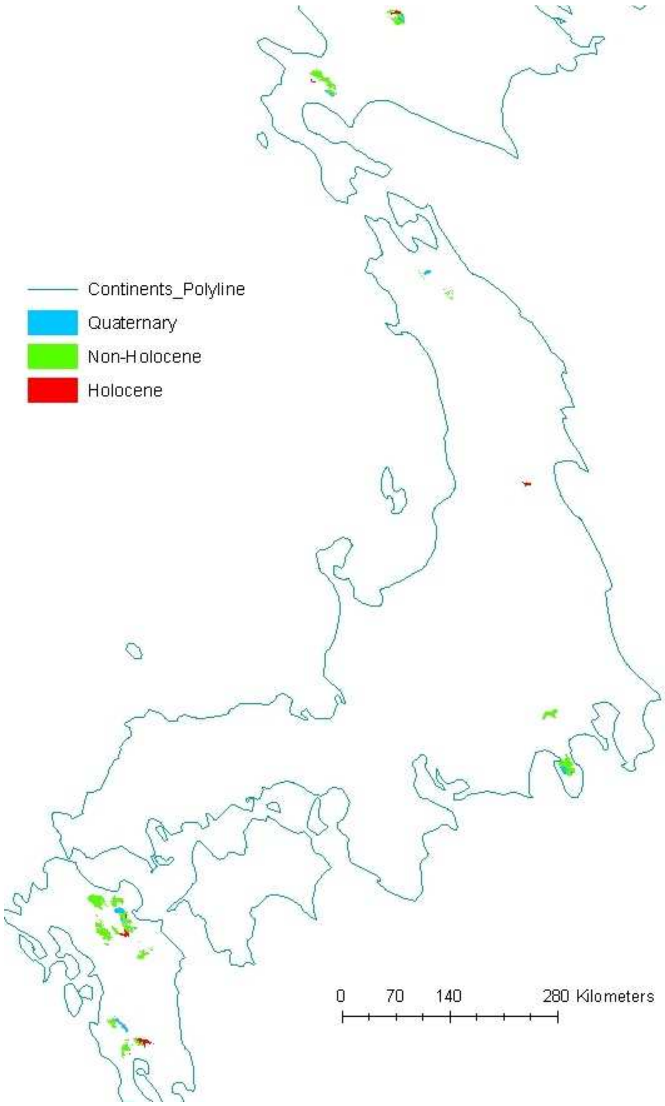
Continents_Polyline
Quaternary
Non-Holocene
Holocene
0 70 140 280 Kilometers

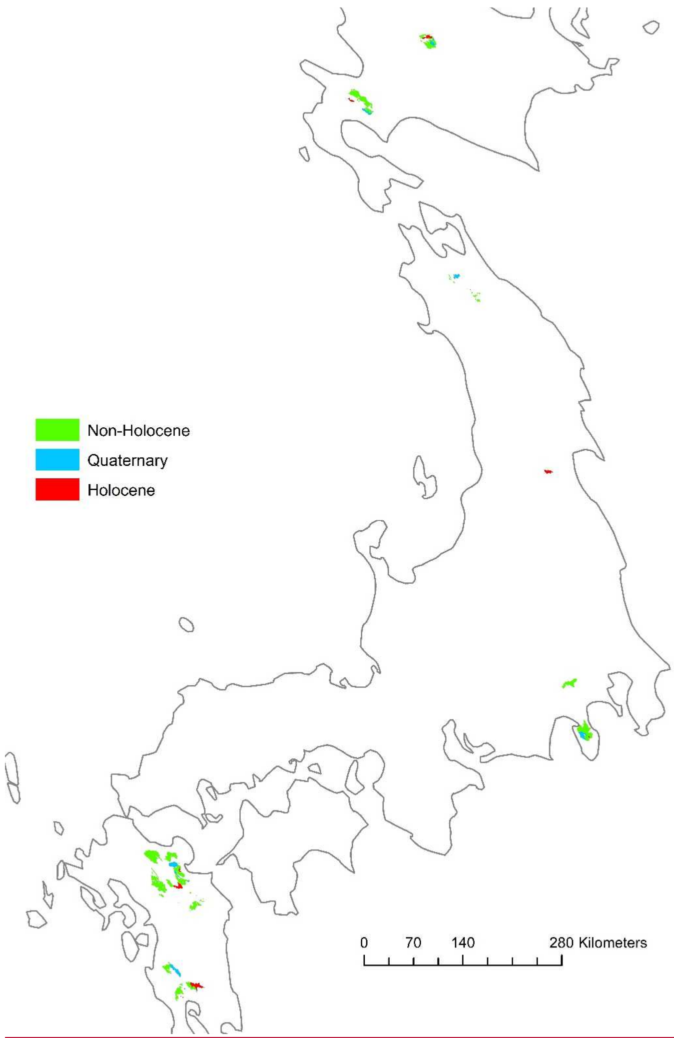

Figure S7: Map showing the watersheds and age classification of basaltic rocks for Japan.

Kamchatka (No.27)

The information of the basaltic rocks of the Kamchatka Peninsula is taken ~~out of~~from the GLiM, attribute xx='vb' (Hartmann and Moosdorf, 2012) ~~and provides~~with the age ~~information of~~classes Holocene, non-Holocene and Quaternary~~, where the~~. The Holocene fraction ~~is again~~was calculated as for the Virunga province~~.~~ (No.23). The watershed was calculated using sampling locations of Dessert et al. (2009). The Holocene fraction of the watershed of the Kamchatka Peninsula is 2.28%.

Table S16: Classification of basaltic rocks of the Kamchatka Peninsula after the GLiM (first three columns) and our interpretation ("System/Series").

Rock_Description	Age_Min	Age_Max	System/Series
Basalte, Andesite und deren Tuffe	Lower Quaternary	Lower Quaternary	non-Holocene
Basalte, Andesite und deren Tuffe	Middle Quarernary	Middle Quarernary	non-Holocene
volcanogenic formations, basic composition	Pliocene	Pliocene	non-Holocene
Basalte, Andesite und deren Tuffe	Quaternary	Quaternary	Quaternary
volcanogenic formations, basic composition	Upper Cretaceous	Upper Cretaceous	non-Holocene
Basalte, Andesite und deren Tuffe	Upper Quaternary	Middle Quarernary	Quaternary
Basalte, Andesite und deren Tuffe	Upper Quaternary	Upper Quaternary	Holocene

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Table S17: Calculated areas of the Kamchatka Peninsula. Note that the Holocene fraction is calculated considering Holocene area, Quaternary area and total area.

Area Holocene (km^2)	**Area Non-Holocene (km^2)**	**Area Quaternary (km^2)**	**Total Area (km^2)**	**Holocene (%)**
183.60	~~55885~~5,588.34	~~28502~~2,850.52	~~86228~~8,622.46	2.28

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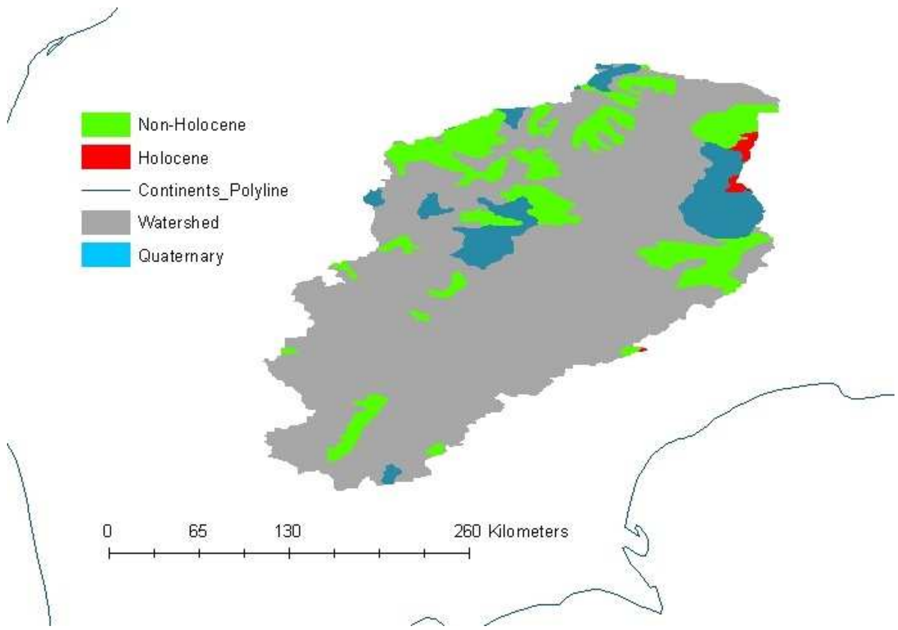

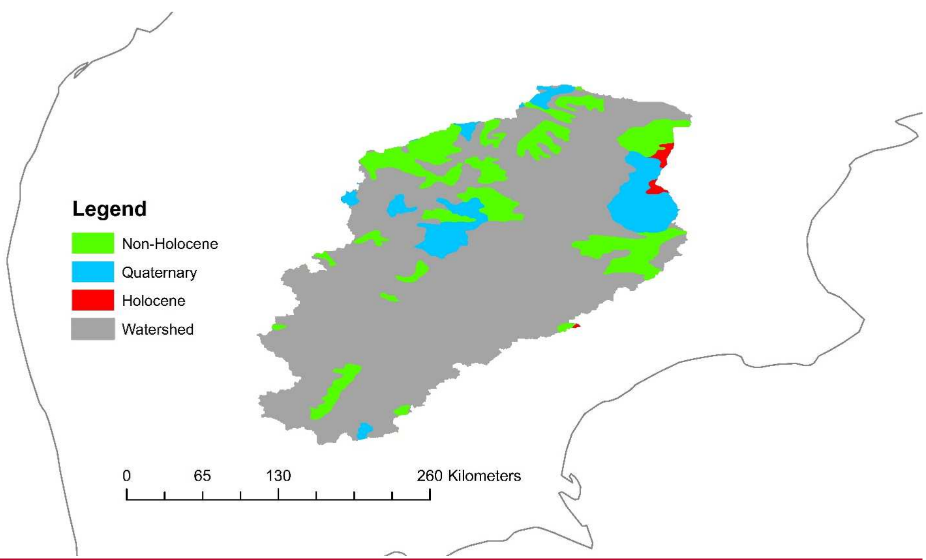

Figure S8: Map showing the watershed of the Kamchatka Peninsula.

Taranaki (No.28)

Taranaki volcano is located in the southern part of the Northern Island of New Zealand. Price et al. (1992) define four different regions of the Taranaki Volcanics (Paritutu, Kaitake, Pouakai and Egmont), where Mt. Egmont is the youngest. After Neall et al. (1986) the cone of Mt. Egmont represents about 8% of the total eruptive mass and is of an age of about 10ka (Holocene).with Mt. Egmont as the youngest one. After Price et al. (1992) and references therein the cone of Mt. Egmont represents about 8% of the total eruptive mass and is of an age of about 10 ka (Holocene). Note that Mt. Egmont is not only composed of basalts but also of basaltic andesites and andesites (Price et al., 1992). We assume here a predominantly basaltic composition.

Big Island, ~~Hawaii~~Hawaii' (No.29)

The geological map of ~~the~~ Big Island of ~~Hawaii~~Hawaii' was digitized after ~~an original~~a map of Stearns and Macdonald (1946). ~~Besides a separation into Holocene and non-Holocene rocks, two different types of~~ The Holocene fraction of the Kilauea and Mauna Loa was calculated as~~Quaternary rocks exist~~:

~~Qu1: Hualalai Volcano: fraction Holocene = Area Qu1 x (11700a / 2580000a)~~

~~Qu2: Kilauea and Mauna Loa Volcano: fraction Holocene = Area Qu2 x (11700a / 126000a)~~ $Holocene\ fraction\ of\ quaternary\ areas = Area\ Quaternary * \left(\frac{11{,}700}{126{,}000}\right)$

with ~~an~~the assumption ~~of~~that "Latest Pleistocene" = Upper Pleistocene (0.126Ma).

~~In~~The total~~, a~~ Holocene fraction ~~of 13.73% was~~is 14.08%, calculated~~.~~ by:

$$Holocene\ fraction = \frac{\left(Area\ Holocene + Area\ Quaternary * \left(\frac{11{,}700}{126{,}000}\right)\right)}{Total\ area}$$

Table S18: Classification of the basaltic rocks of ~~the~~ Big Island of ~~Hawaii~~Hawaii' after Stearns and Macdonald (1946) and our interpretation ("System/Series").

Id	Volcano	Description	Age	System/Series
0	Kohala Mountain	~~Hawi~~Hawii' Volcanic Series, Andesite	Pleistocene	~~non-Holocene~~not considered
1	Kohala Mountain	Pololu Volcanic Series	Pliocene and older	non-Holocene
2	Mauna Kea Volcano	Recent lavas	Holocene	Holocene
3	Mauna Kea Volcano	Pleistocene lavas	Pleistocene	non-Holocene
4	Mauna Kea Volcano	Hamakua Volcanic Series, capped by Pahala ash	Pleistocene	non-Holocene
5	Hualalai Volcano	Historic lavas	Holocene	Holocene
6	Hualalai Volcano	Prehistoric lavas, partly younger or older than Waawaa volcanics	Quaternary	non-Holocene~~Quaternary1~~
7	Hualalai Volcano	Waawaa Volcanics (pumice cone, trachyte lava flow, partly covered with	Pleistocene	~~non-Holocene~~not considered

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		basaltic lavas and Pahala ash)		
8	Kilauea Volcano	Historic lavas	Holocene	Holocene
9	Kilauea Volcano	Prehistoric lavas	Recent and latest Pleistocene	~~Quaternary2~~Quaternary
10	Kilauea Volcano	Hilina Volcanic Series, capped by Pahala ash	Pleistocene	non-Holocene
11	Mauna Loa Volcano	Historic lavas	Holocene	Holocene
12	Mauna Loa Volcano	Prehistoric lavas	Recent and latest Pleistocene	Quaternary~~Quaternary2~~
13	Mauna Loa Volcano	Kahuku Volcanic Series, capped by Pahala ash	Pleistocene	non-Holocene
14	Mauna Loa Volcano	Ninole Volcanic Series	Pliocene or older	non-Holocene

Table S19: Summary of the calculated areas for ~~the Big Island of Hawaii~~Big Island of Hawaii'. The Holocene fraction was calculated applying the above mentioned equation considering the Holocene area, Quaternary area and total area.

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
929.17	~~3357.53~~3,786.30	~~6252.29~~5,535.87	~~10539.00~~10,251.34	~~13.73~~14.08

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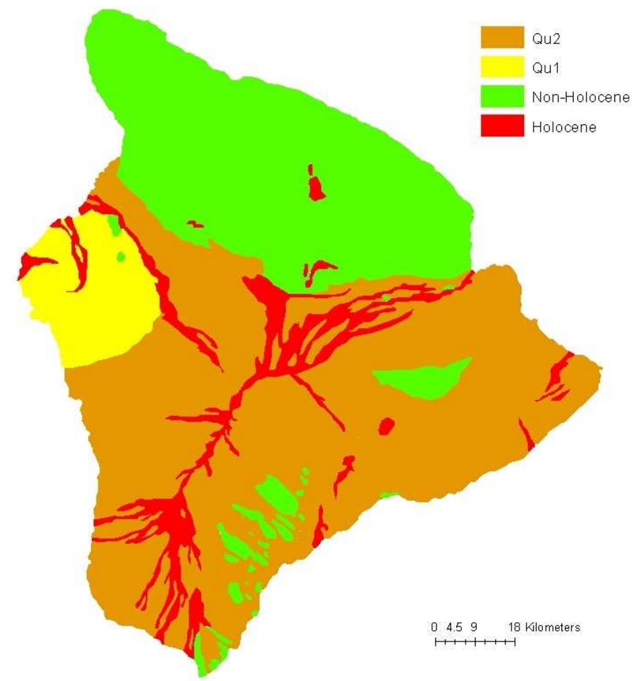
Qu2
Qu1
Non-Holocene
Holocene
0 4.5 9 18 Kilometers

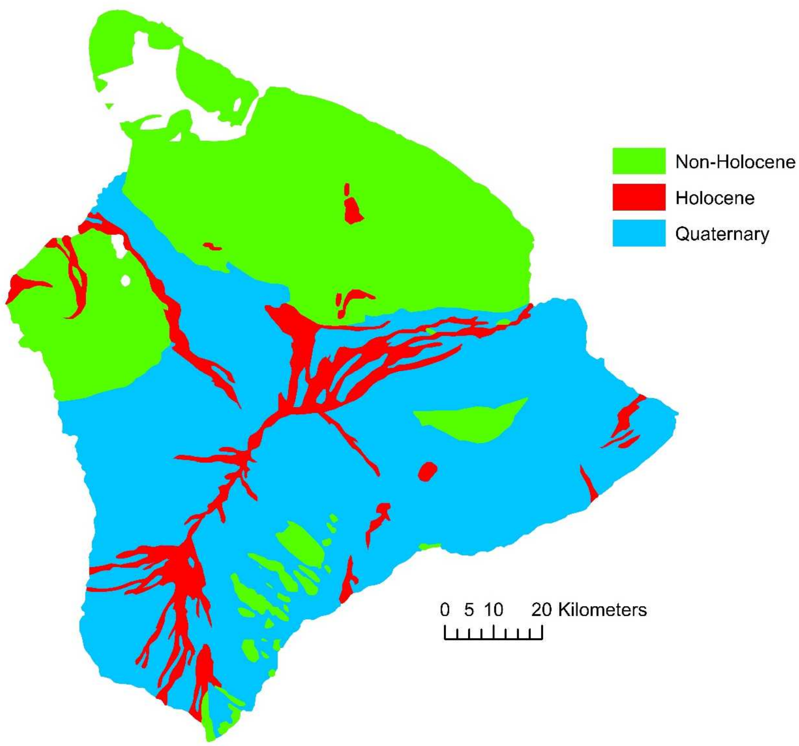

Figure S9: Map of ~~the~~ Big Island of ~~Hawaii~~Hawaii’ showing the different age distributions of basaltic rocks.

High Cascades (No.30)

The geological information for the High Cascades was ~~derived of~~taken from the GLiM by Hartmann and Moosdorf (2012)~~ and results in a Holocene fraction of 0.20%.~~

. The Holocene fraction was calculated as for the Virunga province (No.23)and is 0.20%. The shapefiles of the watersheds are based on the GLORICH database (Hartmann et al., 2014).

Table S20: Classification of the basaltic rocks of the High Cascades Region after the Global Lithological Map, attribute xx='vb' (first three columns) and our interpretation ("System/Series").

Rock_Description	Age_Min	Age_Max	System/Series
basalt;	Early to Middle Miocene	Early to Middle Miocene	non-Holocene
tholeiite; siltstone	Eocene	Eocene	non-Holocene
basalt; andesite	Late Eocene to Oligocene	Late Eocene to Oligocene	non-Holocene
mafic volcanic rock;	Late Miocene to Pliocene	Late Miocene to Pliocene	non-Holocene
basalt; volcanic breccia (agglomerate)	Middle Eocene to Late Eocene	Middle Eocene to Late Eocene	non-Holocene
basalt (tholeiite); andesite	Middle Miocene	Middle Miocene	non-Holocene
basalt;	Middle Miocene	Middle Miocene	non-Holocene
andesite; basalt	Middle to Late Miocene	Middle to Late Miocene	non-Holocene
basalt; andesite	Miocene	Miocene	non-Holocene
basalt; rhyolite	Miocene-Pliocene	Miocene-Pliocene	non-Holocene
basalt; volcanic breccia (agglomerate)	Oligocene to Miocene	Oligocene to Miocene	non-Holocene
basalt; andesite	Pleistocene to Holocene	Pleistocene to Holocene	Quaternary
basalt; andesite	Pliocene to Pleistocene	Pliocene to Pleistocene	non-Holocene
andesite; basalt	Quaternary	Quaternary	Quaternary
andesite; basalt	Tertiary (2-24 Ma)	Tertiary (2-24 Ma)	non-Holocene
Andesite; basalt	Miocene	Miocene	non-Holocene

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Table S21: Summarized area calculation for the watersheds of the High Cascades. The Holocene fraction was calculated as for the Virunga province (No. 23).

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
0	~~3033~~3,033.92	~~2479~~2,479.39	~~5513~~5,513.31	0.20

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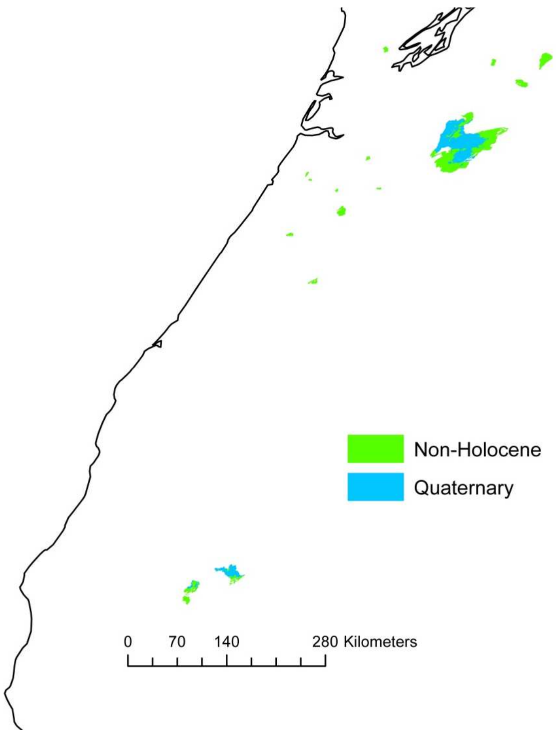
Non-Holocene
Quaternary
0 70 140 280 Kilometers

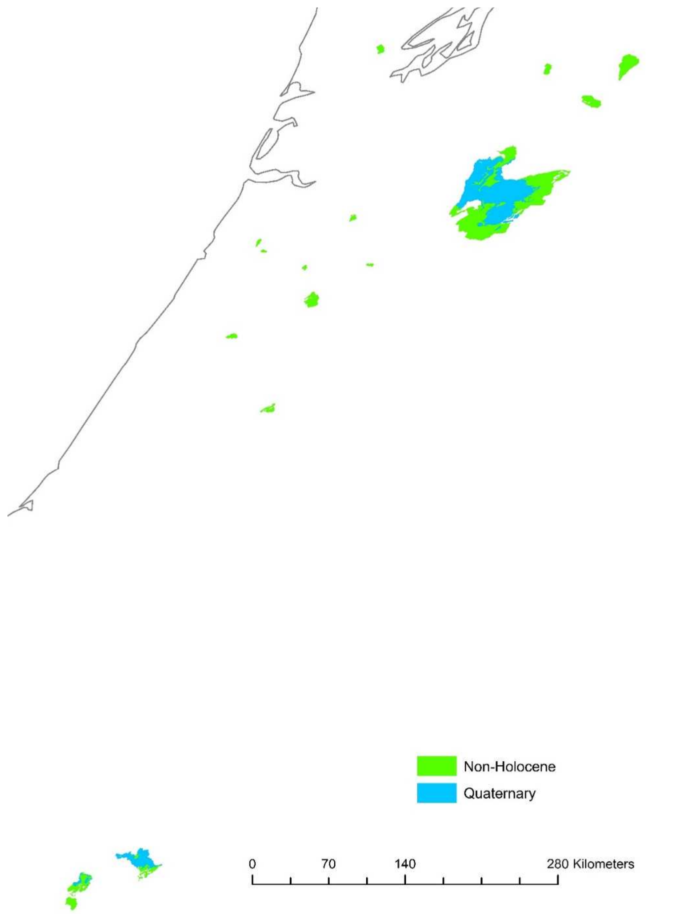

Figure S10: Map of the watersheds of the High Cascades.

Sao Miguel (No.31)

Sao Miguel is related to a Hot Spot in the northern Atlantic. The geological map was digitized after Moore (1990). There are only two watersheds considered in this study and the age of the basaltic rocks can be divided into two different Quaternary classes:

Qu1: fraction Holocene = Area Qu1 x (11700a / 200000a) (Agua de Pau Volcano, 0-200ka)

Qu2: fraction Holocene = Area Qu2 x (11700a / 100000a) (Furnas Volcano, 0-100ka)

Table S22: Classification of the basaltic rocks of Sao Miguel from the original data and our interpretation ("System/Series").

Id	Name	Type	Age	System/Series
2	Agua de Pau Volcano	trachyte stratovolcano	0-200ka	Quaternary1
4	Furnas Volcano	trachyte stratovolcano	0-100ka	Quaternary2

Table S23: Summary of the calculated areas of the watersheds of Sao Miguel.

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
0	0	47.04	47.04	9.35

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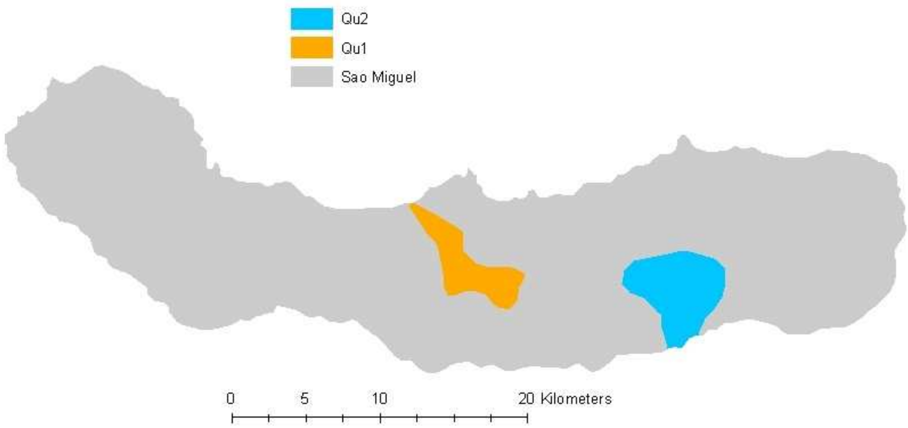

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Figure S11: Map of Sao Miguel showing the two watersheds considered in this study.

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Iceland (No.~~32~~31)

The information of the basaltic rocks of Iceland are ~~derived~~taken from the GLiM (Hartmann and Moosdorf, 2012) and ~~can be~~are classified into Holocene, non-Holocene and Quaternary (for the calculation see Virunga Province, No. 23) and results in a Holocene coverage of 13.19%.

Table ~~S24:~~S22: Description of the basaltic rocks of Iceland after the GLiM, attribute xx='vb' (first three columns) and our interpretation ("System/Series").

Rock_Description	Age_Min	Age_Max	System/Series
Basalt and andesite	Holocene (postglacial time)	Holocene (postglacial time)	Holocene
Basic and intermediate hyaloclastites, lavas and associated sediments	Late Pleistocene	Late Pleistocene	non-Holocene
Basic and intermediate lavas and pyroclastic rocks (mainly hyaloclastite)	Late Pliocene, Early Pleistocene, 3.3 -	Late Pliocene, Early Pleistocene, 3.3 -	non-Holocene
Ocean-floor basalt; on land also intermediate volcanic rocks and sedimentary rocks	Miocene	Miocene	non-Holocene
Basic and intermediate volcanic rocks with intercalated sedimentary rocks	Miocene-Early Pliocene, older than 3.3 M	Miocene-Early Pliocene, older than 3.3 M	non-Holocene
Ocean-floor basalt	Pliocene	Pliocene	non-Holocene
Ocean-floor basalt	Quaternary	Quaternary	Quaternary

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Table ~~S25:~~S23: Summary of the area calculation for Iceland. Note that the Holocene fraction is calculated as for the Virunga province (No. 23).

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Quaternary (km^2)	Total Area (km^2)	Holocene (%)
~~1319~~13,196.86	~~8677~~86,773.61	104.36	~~100075.00~~100,074.83	13.19

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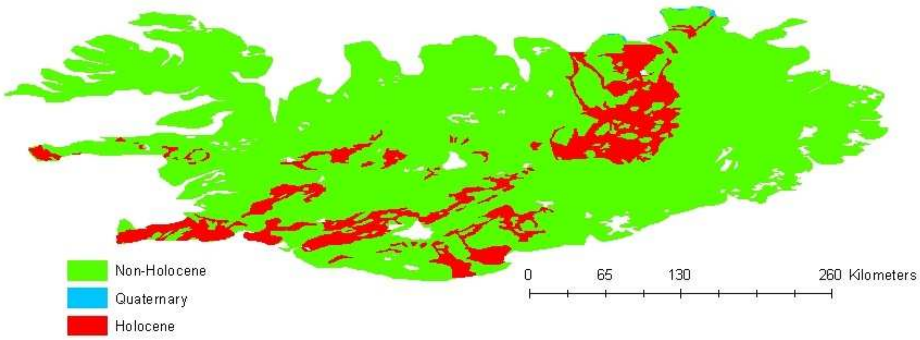
244 

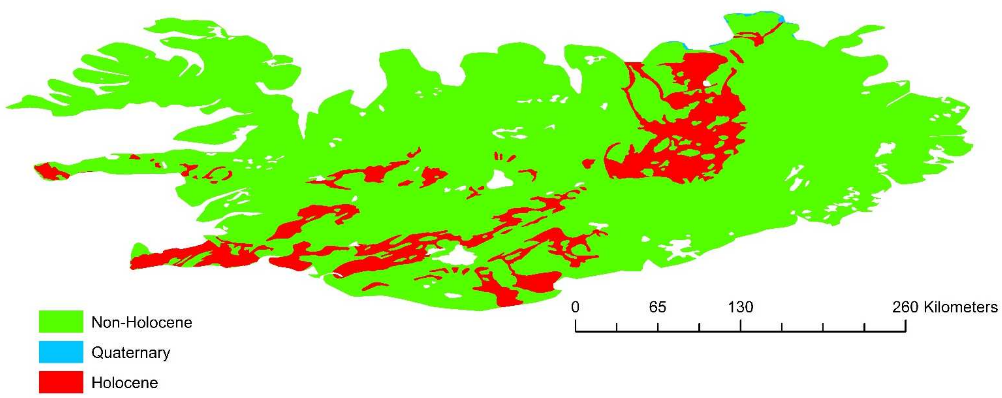
245 

Figure S11:1: Map of Iceland showing the distribution of the age of basaltic rocks.

Sao Miguel (No.32)

Sao Miguel is related to a Hot Spot in the northern Atlantic. The geological map was digitized after Moore (1990). There are only two watersheds considered in this study (Freire et al., 2013). It was assumed that the Holocene area is proportional to the Holocene time span relative to the given mapped quaternary age:

Qu1 (Agua de Pau Volcano, 0 – 200 ka):

$$Holocene\ fraction = Area\ Qu1 * \left(\frac{11{,}700}{200{,}000}\right)$$

Qu2 (Furnas Volcano, 0 – 100 ka):

$$Holocene\ fraction = Area\ Qu2 * \left(\frac{11{,}700}{100{,}000}\right)$$

The final Holocene fraction is 9.35% and is calculated by:

$$Holocene\ fraction = \frac{Area\ Qu1 * \left(\frac{11{,}700}{200{,}000}\right) + Area\ Qu2 * \left(\frac{11{,}700}{100{,}000}\right)}{Total\ Area}$$

The watershed areas are of trachytic composition, therefore Sao Miguel was excluded from the calculations (eq. 5 in the main text) but were kept for comparison because of the generally basaltic environment of the island.

Table S224: Classification of the rocks of the watersheds of Sao Miguel from the original data and our interpretation ("System/Series").

Id	Name	Type	Age	System/Series
2	Agua de Pau Volcano	trachyte stratovolcano	0-200ka	Qu1
4	Furnas Volcano	trachyte stratovolcano	0-100ka	Qu2

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Table S235: Summary of the calculated areas of the watersheds of Sao Miguel. The Holocene fraction was calculated by the above mentioned equation.

Area Holocene (km^2)	Area Non-Holocene (km^2)	Area Qu1 (km^2)	Area Qu2 (km^2)	Total Area (km^2)	Holocene (%)
0	0	18.86	28.18	47.04	9.35

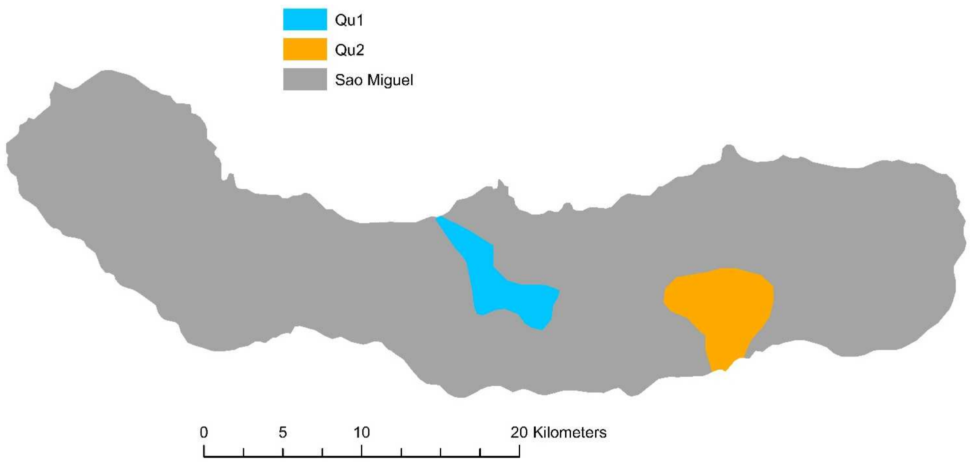

Figure S12: Map of Sao Miguel showing the two watersheds considered in this study.

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Tianchi Lake (No.33)

The geological map of the Tianchi Lake region was ~~derived by~~digitized after Paone and Yun (2016). The ~~basalts can be~~rocks are directly separated into Holocene and non-Holocene age. The total ~~basaltic~~catchment area is 11.31 km² and ~~a~~the Holocene fraction area ~~of~~is 65.34~~% can be calculated.~~%. The value for the runoff was calculated ~~from~~after Fekete et al. (2002).

Table S24: Description of the ~~basaltic~~ rocks of Tianchi Lake after Paone and Yun (2016)~~(~~ (first column) and our interpretation ("System/Series").

Description	System/Series
second fan-shaped debris flow - Holocene	Holocene
Rock-fall deposit - Holocene?	Holocene
1668 dark trachytic ignimbrite and surge - Holocene	Holocene
third fan-shaped debris flow - Holocene	Holocene
1903 phreatomagmatic eruption - Holocene	Holocene
Baitoushan III upper trachyte cone with comendite, 0.02-0.22 Ma	non-Holocene
Baithoushan II middly trachyte cone and ignimbrite, 0.25-0.44 Ma	non-Holocene

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Since the lithology is mostly described as trachytic, Tianchi Lake was excluded from the calculations (eq. 5, main text) but kept in this study for comparison.

Table S25: Summary of the area calculation for Tianchi Lake. The Holocene fraction was calculated by the ratio of Holocene area/total area.

Area Holocene (km²)	Area non-Holocene (km²)	Area Quaternary (km²)	Total Area (km²)	Holocene (%)
7.39	3.92	0	11.31	65.34

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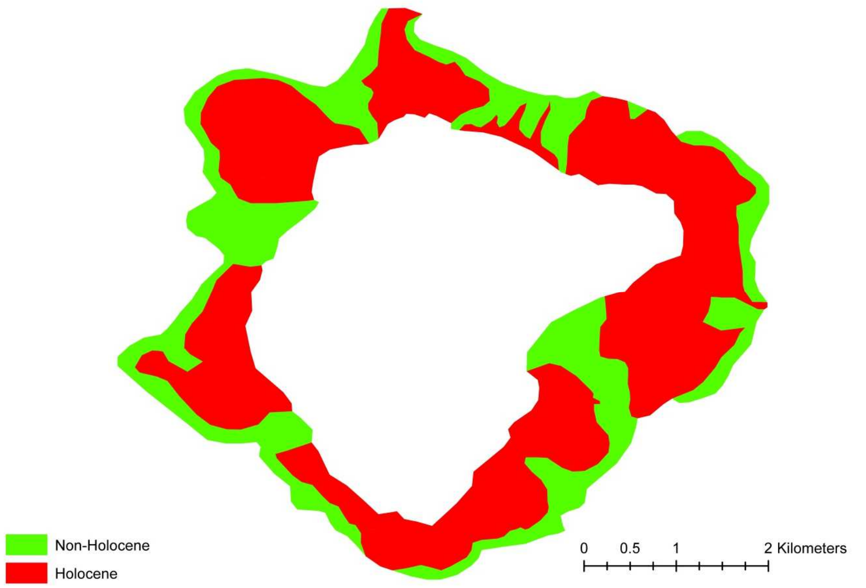
Non-Holocene
Holocene
0 0.5 1 2 Kilometers

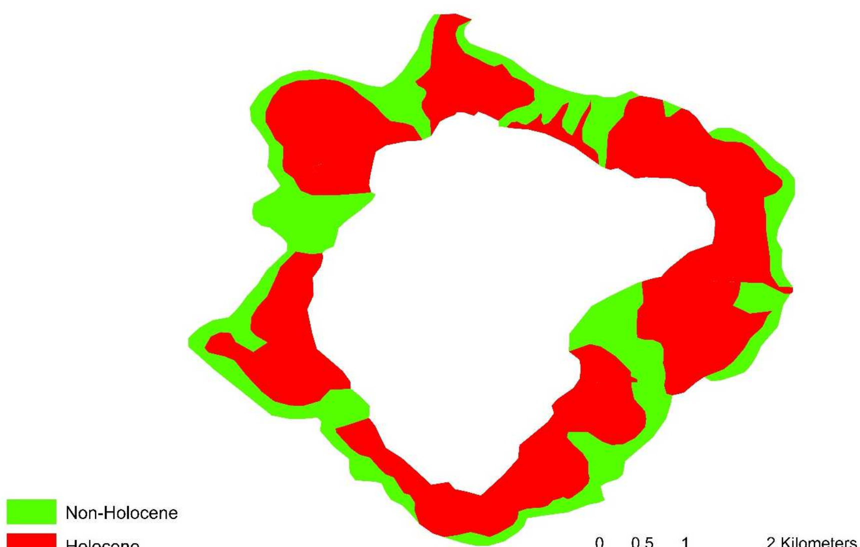
Non-Holocene
Holocene
0 0,5 1 2 Kilometers

Figure S12: Map of Tianchi Lake and its surrounding lithology showing the distribution of the age of ~~basaltic rocks.~~

~~*Part Two*~~*rocks.*

Supplemental Material C: Saturation state with respect to calcite

Data used in the previous study of Li et al. (2016) was derived by published literature and the GLORICH database (Hartmann et al., 2014), but also new river sites of China are included (for more details see Supplementary Information of Li et al. (2016). Li et al. (2016) used either alkalinity or DIC concentrations to calculate the alkalinity flux rates of the individual basaltic volcanic areas. They calculated the alkalinity flux rates by multiplying the mean concentration of dissolved inorganic carbon (DIC) by the annual runoff.

For six areas full water chemistry data are available (High Cascades, Japan, NE North America, SE Australia, South Africa and Tasmania), while for others either pH or major cations were not available. For these available data (103 catchments) the saturation index for calcite was calculated. In general, water samples are undersaturated with respect to calcite (77%). From the oversaturated samples 50% have values close to 0 with an saturation index SI < 0.5. A SI ~ 0.5 is the typical value for rivers in limestone areas (Romero-Mujalli et al., 2018). The other 12 values are between SI = 0.5 and 0.9 and according water sample locations are mostly in dry areas of South Africa or Australia.

In general, younger active areas have significant contributions of magmatic SO_4 or Cl, which shifts the saturation states normally further to lower, negative values. We cannot conclude from the river data what happens in the aquifer system but reference the study of Jacobson et al. (2015), which quantified the contribution of trace calcite dissolution from basalt using Ca-isotope data.

Supplemental Material D: Additional ~~information on~~ relations ~~among studied parameters~~ between Alkalinity, Reactivity and Holocene area fraction

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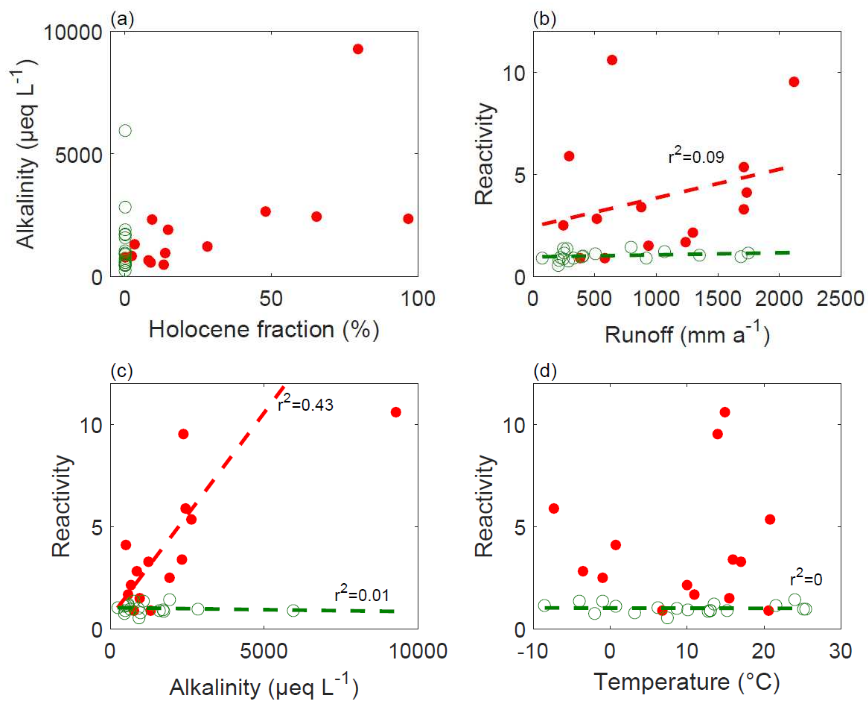
In addition to results provided in the main text further relationships among applied parameters are shown.



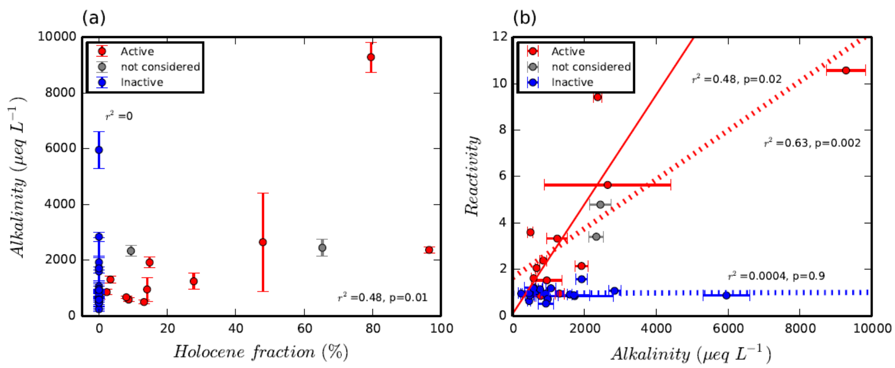


Figure 14S: Scatterplot relationships between alkalinity, Holocene fraction~~, reactivity~~ and ~~temperature~~Reactivity. a) Holocene fraction versus alkalinity concentrations~~. Green~~ (blue: IVFs, red: AVFs~~.~~). b) ~~Reactivity versus runoff: The green regression line (IVFs) suggests almost no correlation of reactivity with runoff, also for the AVFs no significant correlation is identified (~~Alkalinity concentration versus Reactivity: For the AVFs the coefficient of determination is r^2=0.~~09 and slope of~~ 63 (p=0.~~001 with reactivity units per mm runoff a⁻¹; excluding Mt. Etna and Mt. Cameroon). c) Reactivity versus alkalinity concentration: Excluding Mt. Etna, a coefficient of determination r² = 0.43 exists, suggesting an increase in reactivity due to~~ 002). However, removing the one outlier with high alkalinity concentration (Mt. Etna) does not suggest that elevated alkalinity ~~concentration for AVFs. d)~~concentrations are responsible in general for elevated Reactivity ~~versus temperature suggests no bias of reactivity due to a temperature effect for AVFs, as reactivity is based on a temperature normalized parameterization. For the IVFs (r²=0) no bias with temperature can be identified due to the good correlation of~~ of AVFs, considering the alkalinity concentration distribution for IVF. The solid red regression line shows the correlation of AVFs excluding Mt. Etna (r^2=0.48, p=0.02).

Supplemental Material E: Estimation of the parameters for the new scaling law

The new scaling law for alkalinity fluxes ~~*with land surface temperature (green line).*~~ (eq. 5, main text) was derived by a Monte Carlo method simulating 10,000 runs selecting randomly temperature and alkalinity flux rates (assuming a normal distribution) within the range of one standard deviation for each volcanic field:

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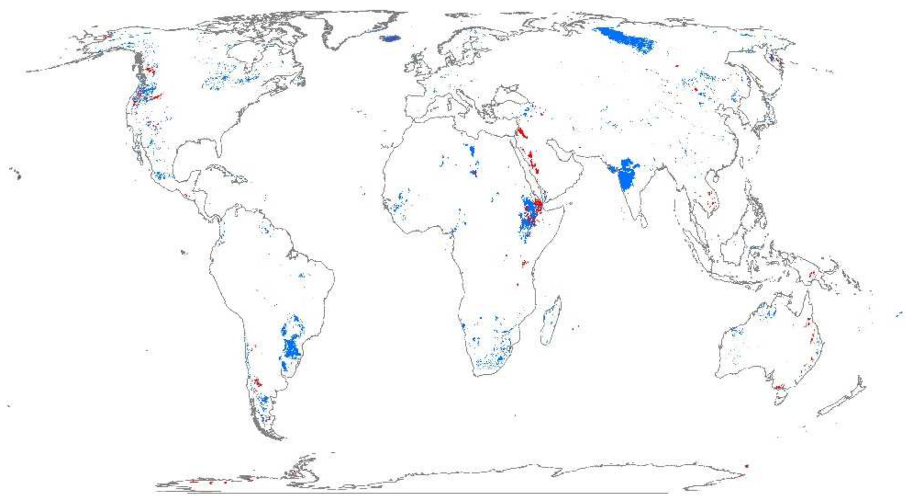
~~*Table S28: Statistical calculations for the previous linear regression with standard deviations of the parameters. The absolute difference Dr is calculated by: CO_2*~~

consumption$_{observed}$ – CO_2 consumption$_{predicted}$ and the slope x_i-x_{mean} is derived by: Holocene fraction – average Holocene fraction.

No.	Name	Volcanic activity	CO_2 consumption [10^6 mol/km^2/a]		Residuals		Slope	
			observed	predicted	D_r	D_r^2	x_i-x_{mean}	$(x_i$-$x_{mean})^2$
1	Massif Central	Inactive	0.372	0.366	0.005	0.000	-11.849	140.401
2	South Africa	Inactive	0.420	0.483	-0.063	0.004	-11.849	140.401
3	Karelia	Inactive	0.131	0.175	-0.044	0.002	-11.849	140.401
4	Coastal Deccan	Inactive	1.110	1.140	-0.030	0.001	-11.849	140.401
5	Interior Deccan	Inactive	1.138	1.164	-0.025	0.001	-11.849	140.401
6	Siberia Traps	Inactive	0.127	0.111	0.016	0.000	-11.849	140.401
7	E'Mei	Inactive	0.321	0.308	0.012	0.000	-11.849	140.401
8	Lei-Qiong	Inactive	1.532	1.056	0.475	0.226	-11.849	140.401
9	Nanjing	Inactive	0.526	0.575	-0.048	0.002	-11.849	140.401
10	Xiaoxinganling	Inactive	0.259	0.187	0.072	0.005	-11.849	140.401
11	Tumen River	Inactive	0.208	0.152	0.056	0.003	-11.849	140.401
12	Mudan River	Inactive	0.204	0.250	-0.046	0.002	-11.849	140.401
13	SE Australia	Inactive	0.441	0.493	-0.053	0.003	-11.849	140.401
14	Tasmania	Inactive	0.377	0.404	-0.027	0.001	-11.849	140.401
15	North Island	Inactive	0.439	0.493	-0.054	0.003	-11.849	140.401
16	Kauai, Hawaii	Inactive	1.026	0.894	0.133	0.018	-11.849	140.401
17	Columbia Plateau	Inactive	0.189	0.335	-0.146	0.021	-11.849	140.401
18	NE America	Inactive	0.235	0.211	0.025	0.001	-11.849	140.401
19	Madeira Island	Inactive	0.618	0.511	0.107	0.011	-11.849	140.401
20	Easter Island	Active	0.757	1.104	-0.347	0.120	-8.489	72.065
21	Mt. Cameroon	Active	5.020	5.431	-0.411	0.169	84.714	7176.452
22	Mt. Etna	Active	5.943	4.861	1.082	1.170	67.711	4584.767
23	Virunga	Active	4.522	4.749	-0.227	0.052	36.171	1308.335
24	La Réunion	Active	2.127	2.408	-0.282	0.079	16.281	265.068
25	Wudalianchi Lake	Active	0.466	0.454	0.013	0.000	2.971	8.826
26	Japan	Active	0.722	0.788	-0.066	0.004	-3.149	9.917
27	Kamchatka	Active	0.444	0.192	0.252	0.064	-9.569	91.568
28	Taranaki	Active	0.864	0.709	0.156	0.024	-3.849	14.816
29	Big Island, Hawaii	Active	0.889	1.354	-0.466	0.217	1.881	3.538
30	High Cascades	Active	0.296	0.328	-0.031	0.001	-11.649	135.701
31	São Miguel	Active	2.047	1.152	0.895	0.801	-2.499	6.245
32	Iceland	Active	0.864	0.477	0.386	0.149	1.341	1.798
33	Tianchi Lake	Active	0.711	0.881	-0.169	0.029	53.491	2861.277
	variance					0.096		0.000
	standard deviation					0.311		0.002

~~**Part Three: Description of the global calculations**~~

~~For the global calculations of alkalinity fluxes, temperature data from Hijmans et al. (2005) and runoff data from Fekete et al. (2002) were used, as well as a global basalt map, mostly based on the GLiM (Fig. S15) distinguishing areas considering Holocene area fractions for the calculations (Cenozoic) and non-Cenozoic basaltic areas.~~



$$X = \left((\bar{x} + std) - (\bar{x} - std)\right) * rand + (\bar{x} - std)$$

With X = calculated value for temperature or alkalinity flux rate,

$\bar{x}$ = mean value of temperature or alkalinity flux rate,

std = standard deviation of temperature or alkalinity flux rate

“Rand” is a function from Matlab software which creates uniformly distributed random numbers (The MathWorks Inc., 2016).

The calculated standard deviations of weighted mean values σ_m for temperature and alkalinity flux rates (Table S1) are taken from Li et al. (2016). The new scaling law is represented by the equation:

$$Alkalinity\ flux\ rate = (1 + b1 * Holocene\ fraction) * b2 * e^{b3*Temperature}$$

Applying the Levenberg-Marquardt algorithm to the 10,000 sets of alkalinity flux rates and temperature the following mean b-parameters of the equation were found:

b_1 = 0.10 with standard deviation=0.02 and median = 0.10

b_2 = 0.23 with standard deviation=0.09 and median = 0.23

b_3 = 0.06 with standard deviation=0.02 and median = 0.06

The mean residual standard deviation (mrsd) of eq. 5 is 0.3 calculated by the following equation:

$$mrsd = \sqrt{\frac{\sum(residual)^2}{n-2}}$$

Calculating the regression of calculated alkalinity flux rates and estimated alkalinity flux rates by the new scaling law provides an $r^2=0.96$ and $p<10^{-3}$.

The linear regression of Holocene fractions and Reactivity for AVFs gives an $r^2=0.93$ and $p=0.01$.

Supplemental Material F: Global calculations CO_2 consumption by basalt weathering

The calculation of the global CO_2 consumption fluxes by the new scaling law (table S28 and S29, and table 1 in the main text) was done by using the calculated set of 10,000 b-parameters (Levenberg-Marquardt-algorithm see above, Supplemental Material E) and global datasets of temperature and runoff (Fekete et al., 2002; Hijmans et al., 2005), as well as the new global basalt map (Fig. S15). The fluxes were calculated 10,000 times (according to the set of b-parameters) for each grid cell. Finally, we calculated the mean values of the fluxes, as well as the standard deviations and the percentiles for 25% and 75% of the global fluxes. This method does not consider the uncertainty due to the residuals.

The global basalt map, mostly based on the GLiM (Fig. S15) distinguishes Holocene, Cenozoic and non-Cenozoic basaltic areas. The calculations were run within a 20 km grid resolution.

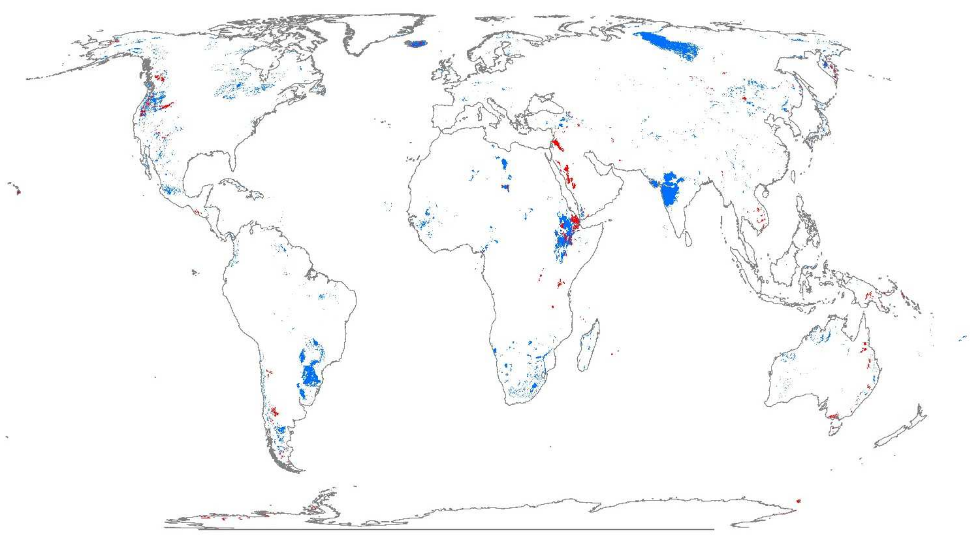


Figure S15: Global distribution of basalt areas distinguishing Cenozoic (red) and Non-Cenozoic areas (blue). The reported Holocene fractions of the Cenozoic areas are *considered in the global calculation. Some areas with missing age information were considered as of non-Holocene age and may result in a smaller global Holocene area fraction ~~than~~ applied for global calculations. The compilation is described in Supplemental Material G.*

Calculating the global fluxes only once by applying the new scaling law with the mean b-parameters to every grid cell, and using the global datasets of temperature and runoff (Fekete et al., 2002; Hijmans et al., 2005), as well as the global basalt map. Here, the global flux with runoff restriction is 2 x 10^{12} mol a^{-1}. Adding the standard deviation to every grid cell results in a flux of 3 x 10^{12} mol a^{-1} and substracting the standard deviation to every grid cell results in 1 x 10^{12} mol a^{-1}, which is representing the range of uncertainty.

Table S29S28: Global calculations of CO_2 consumption for areas with a runoff >74mm/a. As reference previous global empirical equations (Bluth and Kump, 1994; Amiotte-Suchet and Probst, 1995; Dessert et al., 2003; Goll et al., 2014; Suchet and Probst, 1995)were used to derive CO_2 consumption values were applied to derive global CO_2 consumption values. The *values of the new scaling law in this table and in table S29 are given by simulating 10,000 runs (see above). "p25" and "p75" represent the calculated percentiles of 25% and 75%, respectively and "std" the standard deviation.*

	Total Area [km^2]	Holocene Area [km^2]	% of global basalt area	CO_2 consumption [10^6 mol/a] Goll et al., 2014	Dessert et al., 2003	Amiotte-Suchet & Probst, 1995	Bluth & Kump, 1994	New equation	Area [km^2] for q>74mm/a	Holocene area [km^2] for q>74mm/a
Fluxes from purely Holocene areas	55,949	55,949	1.05	17,138	19,388	15,511	11,512	115,206	33,785	33,785
Raster with Holocene influence (Cenozoic)	932,137	55,949	17.46	233,458	247,648	118,919	93,678	314,148	359,190	33,785
Raster without Holocene influence (Non-Cenozoic)	4,406,263	-	82.54	1,237,066	1,319,226	719,451	645,354	1,677,456	3,032,768	-
TOTAL	5,338,400	55,949	100.00	1,470,525	1,566,874	838,371	739,032	1,991,604	3,391,958	33,785

	Total Area [km^2]	Holocene Area [km^2]	% of global basalt area	CO_2 consumption [10^6 mol/a] Goll et al., 2014	Dessert et al., 2003	Amiotte-Suchet & Probst, 1995	Bluth & Kump, 1994	New scaling law	p25	p75	std	Area [km^2] for q>74mm/a	Holocene area [km^2] for q>74mm/a
Fluxes from purely Holocene areas	48,593	48,593	0.92	15,531	17,453	13,560	10,060	100,037	89,216	109,234	14,487	29,213	29,213
Raster with Holocene influence (Cenozoic)	903,600	48,593	17.03	225,938	239,122	112,221	88,208	283,726	276,351	292,969	13,074	338,800	29,213
Raster without Holocene influence (Non-Cenozoic)	4,401,200	-	82.97	1,340,243	1,430,216	750,618	658,218	1,646,033	1,586,658	1,708,683	91,215	3,059,600	-
TOTAL	5,304,800	48,593	100.00	1,566,181	1,669,338	862,839	746,427	1,929,759	1,868,357	1,992,574	92,519	3,398,400	29,213

Table ~~S30~~S29: Global ~~calculations~~CO_2 consumption by basalt weathering without runoff restriction. as applied in Table S28.

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	Total Area [km²]	Holocene Area [km²]	% of global basalt area	CO_2 consumption [10^6 mol/a]				
				Goll et al., 2014	Dessert et al., 2003	Amiotte-Suchet & Probst, 1995	Bluth & Kump, 1994	New equation
Fluxes from purely Holocene areas	55,949	55,949	1.05	17,227	19,484	15,564	11,701	249,201
Raster with Holocene influence (Cenozoic)	932,137	55,949	17.46	234,714	249,063	119,831	96,017	805,917
Raster without Holocene influence (Non-Cenozoic)	4,406,263	-	82.54	1,241,945	1,324,164	722,929	657,897	2,625,217
TOTAL	5,338,400	55,949	100.00	1,476,659	1,573,227	842,760	753,915	3,431,134

	Total Area [km²]	Holocene Area [km²]	% of global basalt area	CO_2 consumption [10^6 mol/a]							
				Goll et al., 2014	Dessert et al., 2003	Amiotte-Suchet & Probst, 1995	Bluth & Kump, 1994	New scaling law	p25	p75	std
Fluxes from purely Holocene areas	48,593	48,593	0.92	15,646	17,577	13,628	10,209	209,602	195,275	223,222	19,264
Raster with Holocene influence (Cenozoic)	903,600	48,593	17.03	227,716	241,036	113,265	90,347	735,004	707,519	763,323	38,618
Raster without Holocene influence (Non-Cenozoic)	4,401,200	-	82.97	1,351,814	1,442,505	756,928	670,733	2,534,801	2,434,265	2,646,095	161,340
TOTAL	5,304,800	48,593	100.00	1,579,530	1,683,541	870,193	761,081	3,269,805	3,150,147	3,404,366	193,745

Supplemental Material G: Enhanced global basalt map beyond GLiM

A new global basalt map was ~~derived by the combination of~~created combining several ~~different input~~ datasets. Main input is ~~from~~ the Global Lithological Map (GLiM) (Hartmann and Moosdorf, 2012)~~ whereas new~~. New, additional data ~~comes~~were taken from geological maps that were considered for the development of the Global Unconsolidated Sediments Map database(GUM) ~~(Börker et al., 2018)~~(Börker et al., 2018) and the individual active volcanoes described in this study. For the individual calculation of Holocene percentages see following tables.

Table ~~S29:~~S30: Table showing the ~~Ages~~ages of the basaltic fields of the GLiM with the authors interpretation (third column). Note that only areas with Holocene fraction are listed. All other age descriptions of the GLiM were considered as of non-Holocene age.

Age_Min	Age_Max	HoloceneArea
~~Early Pleistocene~~	~~Early Pleistocene~~	~~0~~
~~Himalayan Pleistocene~~	~~Himalayan Pleistocene~~	~~0~~
~~Late Miocene to Pleistocene~~	~~Late Miocene to Pleistocene~~	~~0~~
~~Late Pleistocene~~	~~Late Pleistocene~~	~~0~~
~~Late Pliocene, Early Pleistocene, 3.3 -~~	~~Late Pliocene, Early Pleistocene, 3.3 -~~	~~0~~
~~Lower Quaternary~~	~~Lower Quaternary~~	~~0~~
~~Lower Quaternary~~	~~Miocene~~	~~0~~
~~Middle Pleistocene~~	~~Middle Pleistocene~~	~~0~~
~~Middle Quarernary~~	~~Middle Quarernary~~	~~0~~
~~Miocene to Pleistocene~~	~~Miocene to Pleistocene~~	~~0~~
~~Mostly Pleistocene~~	~~Mostly Pleistocene~~	~~0~~
~~Neogene~~	~~Paleogene~~	~~0~~
~~Neogene~~	~~Neogene~~	~~0~~
~~Paleogene to Neogene~~	~~Paleogene to Neogene~~	~~0~~
~~Pleistocene~~	~~Pliocene~~	~~0~~
~~Pleistocene~~	~~Pleistocene~~	~~0~~
~~Pleistocene~~	~~Late Miocene~~	~~0~~
~~Pleistocene and Neocene~~	~~Pleistocene and Neocene~~	~~0~~
~~Pliocene to Pleistocene~~	~~Pliocene to Pleistocene~~	~~0~~
~~Quartär, Pleistozän~~	~~Quartär, Pleistozän~~	~~0~~
~~Quaternary (0.15 Ma)~~	~~Pleistocene (0.15 Ma)~~	~~0~~
~~Quaternary (0.23 Ma)~~	~~Pleistocene (0.23 Ma)~~	~~0~~
~~Quaternary (0.26Ma)~~	~~Quaternary (0.26Ma)~~	~~0~~
~~Quaternary (0.37 Ma)~~	~~Pleistocene (0.37 Ma)~~	~~0~~
~~Quaternary (0.64-0.7Ma)~~	~~Quaternary (0.64-0.7Ma)~~	~~0~~
~~Quaternary (0.89 Ma)~~	~~Pleistocene (0.89 Ma)~~	~~0~~
~~Quaternary (1.1 Ma)~~	~~Quaternary (1.1 Ma)~~	~~0~~
~~Quaternary (1.29 Ma)~~	~~Quaternary (1.29 Ma)~~	~~0~~
~~Quaternary, >0.2Ma~~	~~Pleistocene, >0.2Ma~~	~~0~~

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Cainozoic	Cainozoic	0.02
Cenozoic	Cenozoic	0.02
<u>Oligocene</u>	<u>Cainozoic</u>	<u>0.02</u>
Quaternary	Tertiary	0.02
Quaternary	Cainozoic	0.02
Quaternary and Tertiary	Quaternary and Tertiary	0.02
QUATERNARY OR TERTIARY	QUATERNARY OR TERTIARY	0.02
Tertiary(?) and Quaternary	Tertiary(?) and Quaternary	0.02
Tertiary-Quaternary	Tertiary-Quaternary	0.02
Oligocene and younger	Oligocene and younger	0.03
Holocene	Miocene	0.05
Miocene to Holocene	Miocene to Holocene	0.05
Miocene to Quaternary	Miocene to Quaternary	0.05
Neogene	Quaternary	0.05
Neogene to Holocene	Neogene to Holocene	0.05
~~quaternary~~	~~neogene~~	~~0.05~~
Quaternary	Neogene	0.05
PLIOCENO-PLEISTOCENO-HOLOCENO	PLIOCENO-PLEISTOCENO-HOLOCENO	0.22
Quaternary	Pliocene	0.22
Quaternary to Pliocene	Quaternary to Pliocene	0.22
Quaternary (0-4 Ma)	Quaternary (0-4 Ma)	0.29
Middle Pliocene to Holocene	Middle Pliocene to Holocene	0.33
Holocene	Pleistocene	0.45
Pleistocene to Holocene	Pleistocene to Holocene	0.45
Quaternary	Upper Quaternary	0.45
Quaternary	Pleistocene	0.45
Quaternary	Quaternary	0.45
Upper Quaternary	Middle Quarernary	0.45
~~Quaternary, <0.4Ma~~	~~Pleistocene, <0.4Ma~~	~~2.93~~
~~Quaternary (<0.27 Ma)~~	~~Pleistocene (<0.27 Ma)~~	~~4.33~~
Late Pleistocene to Holocene	Late Pleistocene to Holocene	9.29
~~Quaternary (ca. 10-20 000 yrs BP)~~	~~Quaternary (ca. 10-20 000 yrs BP)~~	~~17~~
~~Holocene, <40ka~~	~~Holocene, <40ka~~	~~29.25~~
Holocene	Holocene	100
Holocene (postglacial time)	Holocene (postglacial time)	100
Upper Quaternary	Upper Quaternary	100

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Table S261: Table showing the age classifications of additional data of several geological maps that were used for the GUM database with our interpretation (third column). Only the quaternary lithologies were considered. Map sources are: Afghanistan (Doebrich et al., 2006), Australia (Raymond et al., 2012), Austria (Geologische Bundesanstalt (GBA), 2013), Canada (Fulton, 1995), China (China Geological Survey, 2002), Colombia (Gomez Tapias et al., 2015), Ethiopia (Tefera et al., 1996), Japan (Geological Survey of Japan AIST (ed.), 2009), Germany (Bundesanstalt für Geowissenschaften und Rohstoffe, 2007), Tanzania (Geological Survey of Tanzania), USA (Soller et al., 2009).

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~~Table S30: Table showing the age classifications of additional data of several geological maps that were used for the GUM database with our interpretation (third column). Map sources are: Afghanistan (Doebrich et al., 2006), Australia (Raymond et al., 2012), Austria (Geologische Bundesanstalt (GBA), 2013), Bolivia (GeoBolivia, 2000), Canada (Fulton, 1995), Caribbean region (French and Schenk, 2004), China (China Geological Survey, 2002), Colombia (Gomez Tapias et al., 2015), Ethiopia (Tefera et al., 1996), Iran (Pollastro et al., 1999), Japan (Geological Survey of Japan AIST (ed.) (2009), https://gbank.gsj.jp/seamless/download/downloadIndex_e.html, accessed May 2016), North Africa 1 (Alimen et al., 1973), North Africa 2 (Alimen et al., 1978), Russia (Zastrozhnov et al., 2014), Siegen, Trier, Köln, Frankfurt (Main, west) (Bundesanstalt für Geowissenschaften und Rohstoffe, 2007), Spain (Canaries Islands), Spain (Instituto Geológico y Minero de España, 1988), Tanzania (Geological Survey of Tanzania, Geo-Economic Data (1:2M) – Geology, http://www.gmis-tanzania.com/, accessed May 2016), USA (Soller et al., 2009).~~

Age_Min	Age_Max	HoloceneArea
0.19M1 M	0.215M26 M	0
2.5 M	0.26 M	0
0.45M215 M	0.65M19 M	0
Sarmatian/PannonianPlio/Pleistocene	Plio/PleistoceneSarmatian/Pannonian	0
PleistocenePliocene	PleistocenePliocene	0
0.26M	1M	0
0.3M	1M	0
0.01M2.5 M	2.5M0.01 M	0
Early Pleistocene	Early Pleistocene	0
0.126780	0.780126	0
Middle Pleistocene	Middle Pleistocene	0
Late Pleistocene	Late Pleistocene	0
Pleistocene	Pleistocene	0
Middle Pleistocene	Late Pleistocene	0
Early Pleistocene	Middle Pleistocene	0

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Cenozoic	Cenozoic	0.02
023 Ma	23Ma0 Ma	0.05
PlioceneHolocene	PlioceneHolocene	0.22
Quaternary	Quaternary	0.45
HoloceneLate Pleistocene	Late Pleistocene Holocene	9.29
Holocene	Holocene	100

References

~~Alimen, H., Choubert, G., International association for quaternary research, Unesco, 1973. Carte Internationale du Quaternaire de l'Afrique 1:2,500,000 - Afrique du nord / Prepared by the Subcommission of INQUA for the Quaternary map of Africa under the aegis of the National Centre of Scientific Research. United Nations Educational, Scientific and Cultural Organization, Sub-Commission of INQUA for the *Quaternary Map of Africa*, Paris.~~

~~Alimen, H., Choubert, G., International association for quaternary research, Unesco, 1978. Carte Internationale du Quaternaire de l'Afrique 1:2,500,000 - Sahara Occidental / Prepared by the Subcommission of INQUA for the Quaternary map of Africa with the support of the National Centre of Scientific Research. United Nations Educational, Scientific and Cultural Organization, Sub-Commission of INQUA for the *Quaternary Map of Africa*, Paris.~~

~~Balagizi, C.M. et al., 2015.~~Amiotte-Suchet, P., and Probst, J. L.: A global model for present-day atmospheric/soil CO2 consumption by chemical erosion of continental rocks (GEM-CO2), Tellus B, 47, 273-280, 10.1034/j.1600-0889.47.issue1.23.x, 1995.

Antun, P., Gerards, J., and Petricec, V.: Carte Géologique du Rwanda, Feuille Ruhengeri Nord (S2/29 NW et NE), Champs Volcanique des Birunga, Institut Géographique Militaire de Belgique, 1971.

Ateba, B., Dorbath, C., Dorbath, L., Ntepe, N., Frogneux, M., Aka, F. T., Hell, J. V., Delmond, J. C., and Manguelle, D.: Eruptive and earthquake activities related to the 2000 eruption of Mount Cameroon volcano (West Africa), Journal of Volcanology and Geothermal Research, 179, 206-216, 10.1016/j.jvolgeores.2008.11.021, 2009.

Balagizi, C. M., Darchambeau, F., Bouillon, S., Yalire, M. M., Lambert, T., and Borges, A. V.: River geochemistry, chemical weathering, and atmospheric CO2 consumption rates in the Virunga Volcanic Province (East Africa~~).~~), Geochemistry, Geophysics, Geosystems, 16~~(8):~~, 2637-2660, 10.1002/2015GC005999, 2015.

Benedetti, M. F., Dia, A., Riotte, J., Chabaux, F., Gérard, M., Boulegue, J., Fritz, B., Chauvel, C., Bulourde, M., and Déruelle, B.: Chemical weathering of basaltic lava flows undergoing extreme climatic conditions: the water geochemistry record, Chemical Geology, 201, 1-17, 2003.

Bluth, G. J., and Kump, L. R~~., 1994.~~.: Lithologic and climatologic controls of river chemistry~~.~~, Geochimica et Cosmochimica Acta, 58~~(10):~~, 2341-2359, 1994.

Börker, J., Hartmann, J., Amann, T., and Romero~~-~~-Mujalli, G~~., 2018.~~.: Terrestrial sediments of the earth: development of a global unconsolidated sediments map database (GUM~~).~~), Geochemistry, Geophysics, Geosystems, 19, 997-1024, 2018.

Branca, S., Coltelli, M., Groppelli, G., and Lentini, F~~., 2011.~~.: Carta Geologica del vulcano Etna (Scala 1:50.000), Istituto Nazionale di Geofisica e Vulcanologia Osservatorio Etneo sezione di Catania, Istituto per la Protezione e la Ricerca Ambientale (ISPRA), Servizio Geologico d'Italia, CNR-Consiglio Nazionale delle Ricerche, Univerità di Catania Dipartimento di Scienze Geologiche, 2011a.

Branca, S., Coltelli, M., Groppelli, G., and Lentini, F.: Geological map of Etna volcano, 1: 50,000 scale~~.~~, Italian Journal of Geosciences, 130~~(3):~~, 265-291, 2011b.

Bundesanstalt für Geowissenschaften und Rohstoffe~~, 2007.~~: Geologische Übersichtskarte der Bundesrepublik Deutschland (scale 1:200,000 (GÜK200~~).~~)), Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany, 2007.

China Geological Survey~~, 2002.~~: Geological Atlas of China - Chinese geological map (scale 1:2,500,000~~).~~), Geological Press, Beijing, 2002.

De Mulder, M., Hertogen, J., Deutsch, S., and André, L~~., 1986.~~.: The role of crustal contamination in the potassic suite of the Karisimbi volcano (Virunga, African Rift Valley~~).~~), Chemical geology, 57~~(1):~~, 117-136, 1986.

Dessert, C., Dupré, B., Gaillardet, J., François, L. M., and Allègre, C. J~~., 2003.~~.: Basalt weathering laws and the impact of basalt weathering on the global carbon cycle~~.~~, Chemical Geology, 202~~(3–4):~~, 257-273, http://dx.doi.org/10.1016/j.chemgeo.2002.10.001, 2003.

Dessert, C., Gaillardet, J., Dupre, B., Schott, J., and Pokrovsky, O. S.: Fluxes of high- versus low-temperature water–rock interactions in aerial volcanic areas: Example from the Kamchatka Peninsula, Russia, Geochimica et Cosmochimica Acta, 73, 148-169, 10.1016/j.gca.2008.09.012, 2009.

Doebrich, J. L~~. et al., 2006.~~., Wahl, R. R., Ludington, S. D., Chirico, P. G., Wandrey, C. J., Bohannon, R. G., Orris, G. J., and Bliss, J.: Geologic age and lithology of Afghanistan (glgafg.shp~~), ~~) (U.S. Geological Survey Open File Report~~.~~: Issue Identification number 2006-1038), U.S. Geological Survey, Denver, CO. U.S.A., 2006.

Fekete, B. M., Vörösmarty, C. J., and Grabs, W~~., 2002.~~.: High-resolution fields of global runoff combining observed river discharge and simulated water balances~~.~~, Global Biogeochemical Cycles, 16~~(3).~~, 2002.

~~French, C.D., Schenk, C.J., 2004. Surface Geology of the Caribbean Region (geo6bg). U.S. Geological Survey, Central Energy Resources Team, Denver, Colorado.~~

Freire, P., Andrade, C., Coutinho, R., and Cruz, J. V.: Fluvial geochemistry in Sao Miguel Island (Azores, Portugal): source and fluxes of inorganic solutes in an active volcanic environment, Science of the Total Environment, 454-455, 154-169, 10.1016/j.scitotenv.2013.02.090, 2013.

Fulton, R~~., 1995.~~.: Surficial materials of Canada. In~~:~~ Geological Survey of Canada (Editor), Map 1880A, scale 1:5 000 000~~.~~, Natural Resources Canada, Ottawa, Canada, 1995.

~~GeoBolivia, 2000. Mapa geologico de Bolivia, 2000. Servicio Nacional de Geología y Técnico de Minas - SERGEOTECMIN.~~

Geological Survey of Japan AIST (ed~~.), 2009.~~.): Seamless digital geological map of Japan 1:200,000. Dec 15, 2009 version. Research Information Database DB084~~.~~, https://gbank.gsj.jp/seamless/download/downloadIndex_e.html, accessed May 2016, Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, Japan, 2009.

Geological Survey of Tanzania: Geo-Economic Data (1:2M) - Geology, http://www.gmis-tanzania.com/, accessed May 2016

Geologische Bundesanstalt (GBA~~), 2013.~~): Kartographisches Modell 1:500000 Austria - Geologie, Wien, Austria, 2013.

Gioncada, A~~. et al., 2010.~~., Gonzalez-Ferran, O., Lezzerini, M., Mazzuoli, R., Bisson, M., and Rapu, S. A.: The volcanic rocks of Easter Island (Chile) and their use for the Moai sculptures~~.~~, European Journal of Mineralogy, 22~~(6):~~, 855-867, 2010.

Goll, D. S., Moosdorf, N., Hartmann, J., and Brovkin, V~~., 2014.~~.: Climate-driven changes in chemical weathering and associated phosphorus release since 1850: Implications for the land carbon balance~~.~~, Geophysical Research Letters, 41~~(10):~~, 3553-3558, 10.1002/2014GL059471, 2014.

Gomez Tapias, J~~. et al., 2015.~~., Nivia Guevara, A., Montes Ramirez, N. E., Diederix, H., Almanza Melendez, M. F., Alcarcel Gutierrez, F. A., and Madrid Montoya, C. A.: Explanatory notes: Geological Map of Colombia~~. In: Gomez, J., Almanza, M.F. (Eds.),~~, in: Compilando la geologia de Colombia: Una vision a 2015. Servicio Geologico Colombiano, Publicaciones Geológicas Especiales 33, edited by: Gomez, J., and Almanza, M. F., Bogotá, ~~pp.~~ 35-60, 2015.

Hartmann, J., and Moosdorf, N~~., 2012.~~.: The new global lithological map database GLiM: A representation of rock properties at the Earth surface~~.~~, Geochemistry, Geophysics, Geosystems, 13~~(12).~~, 10.1029/2012GC004370, 2012.

Hartmann, J., Lauerwald, R., and Moosdorf, N.: A brief overview of the GLObal RIver CHemistry Database, GLORICH, Procedia Earth and Planetary Science, 10, 23-27, 2014.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G., and Jarvis, A~~., 2005.~~.: Very high resolution interpolated climate surfaces for global land areas~~.~~, International journal of climatology, 25~~(15):~~, 1965-1978, 2005.

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~~Instituto Geológico y Minero de España, 1988. Mapa del Cuaternario de España a escala 1:1.000.000.~~

Jacobson, A. D., Grace Andrews, M., Lehn, G. O., and Holmden, C.: Silicate versus carbonate weathering in Iceland: New insights from Ca isotopes, Earth and Planetary Science Letters, 416, 132-142, http://dx.doi.org/10.1016/j.epsl.2015.01.030, 2015.

Le Maréchal, A.~~, 1975.~~.: Carte geologique de l'ouest du Cameroun et de l'Adamaoua~~.~~, ORSTOM, 1975.

Le Maréchal, A.: Géologie et géochimie des sources thermominérales du Cameroun, Orstom, 1976.

Li, G~~. et al., 2016.~~., Hartmann, J., Derry, L. A., West, A. J., You, C.-F., Long, X., Zhan, T., Li, L., Li, G., Qiu, W., Li, T., Liu, L., Chen, Y., Ji, J., Zhao, L., and Chen, J.: Temperature dependence of basalt weathering~~.~~, Earth and Planetary Science Letters, 443~~:~~, 59-69, http://dx.doi.org/10.1016/j.epsl.2016.03.015, 2016.

Louvat, P., and Allègre, C. J.: Present denudation rates on the island of Reunion determined by river geochemistry: basalt weathering and mass budget between chemical and mechanical erosions, Geochimica et Cosmochimica Acta, 61, 3645-3669, 1997.

Moore, R. B~~., 1990.~~.: Volcanic geology and eruption frequency, São Miguel, Azores~~.~~, Bulletin of Volcanology, 52~~(8):~~, 602-614, 1990.

~~Neall, V., Stewart, R., Smith, I., 1986. History and petrology of the Taranaki volcanoes. Royal Society of New Zealand Bulletin, 23: 251-263.~~

Nehlig, P., Quinquis, J., Bucelle, M., and Odon, O~~., 2006.~~.: Carte géologique de la Réunion~~.~~, BRGM, Bur. de Rech. Geol. et Min., Orleans, France, 2006.

Paone, A., and Yun, S.-H~~., 2016.~~.: Pyroclastic Density Current Hazards at the Baekdusan Volcano, Korea: Analyses of Several Scenarios from a Small-Case to the Worst-Case Colossal Eruption, in: Updates in Volcanology-From Volcano Modelling to Volcano Geology~~.~~, InTech, 2016.

~~Petricec, V., Gerards, J., Antun, P., 1971. Carte Géologique du Rwanda, Feuille Ruhengeri Nord (S2/29 NW et NE), Champs Volcanique des Birunga. Institut Géographique Militaire de Belgique.~~

~~Pollastro, R.M., Persits, F., Steinshouer, D., 1999. Surficial geology of Iran (geo2cg). U.S. Geological Survey, Central Energy Ressources Team.~~

Price, R., McCulloch, M., Smith, I., and Stewart, R~~., 1992.~~.: Pb-Nd-Sr isotopic compositions and trace element characteristics of young volcanic rocks from Egmont Volcano and comparisons with basalts and andesites from the Taupo Volcanic Zone, New Zealand~~.~~, Geochimica et cosmochimica acta, 56~~(3):~~, 941-953, 1992.

Raymond, O. L., Liu, S., Gallagher, R., Highet, L. M., and Zhang, W~~., 2012.~~.: Surface Geology of Australia, 1:1 million scale, dataset 2012 edition~~.~~, Commonwealth of Australia (Geoscience Australia~~).~~), Canberra, 2012.

Romero-Mujalli, G., Hartmann, J., and Börker, J.: Temperature and CO2 dependency of global carbonate weathering fluxes – Implications for future carbonate weathering research, Chemical Geology, https://doi.org/10.1016/j.chemgeo.2018.08.010, 2018.

Smets, B., Wauthier, C., and d'Oreye, N~~., 2010.~~.: A new map of the lava flow field of Nyamulagira (DR Congo) from satellite imagery~~.~~, Journal of African Earth Sciences, 58~~(5):~~, 778-786, 2010.

Soller, D. R., Reheis, M. C., Garrity, C. P., and Van Sistine, D. R~~., 2009.~~.: Map database for surficial materials in the conterminous United States~~.~~, US Geological Survey Data Series, 425, 2009.

Stearns, H. T., and Macdonald, G. A~~., 1946.~~.: Geology and ground-water resources of the island of Hawaii, Honolulu Advertising, 1946.

~~Suchet, P.A., Probst, J.L., 1995. A global model for present-day atmospheric/soil CO2 consumption by chemical erosion of continental rocks (GEM-CO2). Tellus B, 47(1-2): 273-280.~~

Tefera, M., Chernet, T., and Haro, W~~., 1996.~~.: Geological Map of Ethiopia~~.~~, Ministry of Mines, Geological Survey of Ethiopia, GSE~~.~~

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~~Zastrozhnov, A.S. et al., 2014. Map of the Quaternary Formations of the Russian Federation. Ministry of Natural Resources and Ecology of the Russian Federation, Federal Agency on Mineral Resources, Federal State Unitary Enterprise "A.P. Karpinsky Russian Geological Research Institute" (VSEGEI), Federal State Unitary Enterprise "I.S. Gramberg Russian Research Institute for Geology and Mineral Resources of the Ocean" (VNIIOkeangeologia).~~, Addis Ababa, Ethiopia, 1996.

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