Paleo-erosion rate record in a 1.6 Ma terrace sequence of the Meuse river

M. SCHALLER[1,3], F. VON BLANCKENBURG[1,2], N. HOVIUS[3] AND P.W. KUBIK[4]

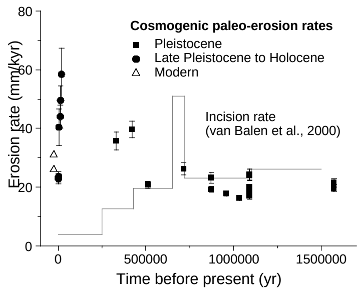
[1] Institut für Geologie, Bern, Switzerland (mirjam@geo.unibe.ch)
[2] Institut für Mineralogie, Hannover, Germany (fvb@mineralogie.uni-hannover.de)
[3] Department of Earth Sciences, Cambridge, England (nhovius@esc.cam.ac.uk)
[4] Paul Scherrer Institute/ Institute of Particle Physics, Zürich, Switzerland (kubik@particle.phys.ethz.ch)

Method

Cosmogenic nuclides in sand of dated river terraces can be used to determine catchment-wide paleo-erosion rates (e.g. Granger and Smith, 2000). The measured nuclide concentration is corrected for post-depositional irradiation using the known age of the terrace. The remaining nuclide inventory reflects the time-integrated catchment-wide erosion rate at the time of terrace deposition.

Results

The paleo-erosion rates derived from cold stage terrace deposits of the Meuse river, the Netherlands (Van den Berg and van Hoof, 2001), are surprisingly uniform at 20 to 25 mm/kyr from 1.6 Ma to 0.4 Ma. After 0.4 Ma the erosion rates increase to 40 to 60 mm/kyr.



Discussion

The increase of paleo-erosion rate after 0.4 Ma might be the result of an increase in river incision rate that was caused by accelerated uplift of the Ardennes mountains at 0.7 Ma (Van Balen et al., 2000). This points to a substantial lag time required for linear incision to propagate into spatial erosion of an entire river basin. The long-term global cooling within this period does not appear to shift cold-stage erosion rates.

References

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Contamination of OIB by underlying ancient continental lithosphere: U-Pb and Hf isotopes in zircons question EM1 and EM2 mantle components

U. SCHALTEGGER[1,2], H. AMUNDSEN[3,4], B. JAMTVEIT[4], M. FRANK[2], W. L. GRIFFIN[5], K. GRÖNVOLD[6], R. TRÖNNES[6] AND T. TORSVIK[7]

[1] University of Geneva, Maraîchers 13, CH-1205 Geneva (urs.schaltegger@terre.unige.ch)
[2] Department of Earth Sciences, ETH Zürich, Sonneggstr. 5, CH-8092 Zürich (frank@erdw.ethz.ch)
[3] Earth and Planetary Exploration Services, N-0364 Oslo (amundsen@planetary-exploration.com)
[4] Department of Physics and Geology, PO Box 1048, N-0316 Oslo (bjorn.jamtveit@geologi.uio.no)
[5] GEMOC, Macquarie University, Sydney, NSW 2109, Australia (wgriffin@laurel.ocs.mq.edu.au)
[6] Nordic Volcanological Institute, Grensasvegur 50, IS-108 Reykjavik (karl@norvol.hi.is; rgt@norvol.hi.is)
[7] Department of Physics and Geology, PO Box 1048, N-0316 Oslo (trond.torsvik@ngu.no)

Intra-oceanic volcanism is attributed to melting within mantle plumes. Isotopic and trace element signatures suggest involvement of melts derived from continental lithospheric material, recycled through deep levels in the convecting mantle, possibly as deep as the core-mantle boundary. Continental material dredged, drilled or reported as outcrops from volcanic ocean islands and submarine ridges, suggests that many volcanic ocean islands are underlain by continental fragments and that OIB's may have assimilated continental material during the passage of melts through the lithosphere. U-Pb and Hf isotopic results of zircon xenocrysts in basalts from Iceland and Mauritius define age and source of recycled material in these melts.

The studied zircons are xenocrystic in basalts and originate from magmatic rocks generated during reworking of Proterozoic continental crust. Examples to be presented include (1) Permian (275 Ma) continental zircons with eps Hf = -3 to –6, and 0.5 and 1.7 Ga inheritance age in basalts from Mauritius, and (2) Lewisian (1.8 Ga) and Jurassic (160 Ma) zircons in basalts from eastern Iceland.

The zircons can not have survived prolonged entrainment at sub-lithospheric mantle temperatures and demonstrate the presence of old continental crust beneath both Iceland and Mauritius. Fragments of continental crust beneath Iceland and Mauritius may represent the southern extensions of the Jan Mayen and Seychelles-Mascarene microcontinents respectively, formed during continental breakup and ridge jumping during ocean spreading. The presence of continental crust beneath Iceland, Mauritius and a series of other volcanic ocean islands calls for great caution in linking EM1/2 components to recycling of crustal material in mantle plumes.