Evolving isotopic fluxes to Asian marginal seas controlled by Monsoon strength since the Last Glacial Maximum

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The intensity of the Asian monsoon is expected to have a major impact on the strength of erosion and chemical weathering in continental river basins. Because these processes are linked to solar insolation there should be major variations in the chemical flux to the ocean on millennial timescales. To test this hypothesis we have examined the erosional response of rivers in different parts of Asia to monsoonal changes since 14 ka. ODP Site 1144 in the South China Sea shows little provenance variation, but a major changes in Sr isotope composition, clay mineralogy, clastic mass accumulation rates and Ti/Ca values. We interpret this to reflect erosion of Pleistocene fluvial terraces in Taiwan and from the exposed Taiwan Strait during early Holocene monsoon intensification. The isotope and chemical proxy pulse lasts from 11 to 8 ka, considerably shorter than the period of strong summer monsoon derived from speleothem records. Assuming these latter to be robust rainfall proxies we suggest that the fall in weathering intensity after 10 ka reflects decline in the erosion of the terraces onshore as the valleys are emptied and the Taiwan Strait was drowned by rising sealevel. In the Pearl River estuary itself we see a clear but different signal. Here $^{87}Sr/^{86}Sr$ values rise after 9 ka and only begin to fall again after 6 ka, reaching minimum values at 3.5 to 1.0 ka. If Sr isotopes are controlled by weathering then the response appears to lag monsoon intensity by ~2 k.y. A major increase in $^{87}Sr/^{86}Sr$ after 1.0 ka and the large mis-match between modern river sediments and the Holocene delta suggests major changes in erosion patterns, probably caused by the expansion of farming. Further west in the Indus delta Nd and Sr isotopes change quickly during from 14 to 9 ka as the monsoon intensifies, likely driven by changing patterns of erosion as the location of heaviest rains migrates. In the offshore shallow delta rising $^{87}Sr/^{86}Sr$ values during the early Holocene also suggest stronger chemical weathering. The effect is strongest in the early Holocene, but does not reduce after the weakening of the monsoon after ~5 ka. We suggest that reworking of older more weathered material from the flood plain at that time buffers the flux to the ocean. Although a wetter monsoon might be expected to drive more chemical weathering we find that on millennial timescales reworking of material formed during drier glacial times is often the source of the most weathered materials.

H isotopes in lavas from Loihi and Pitcairn: Primitive or recycled water?

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Hotspots sample mantle domains distinct from mid-ocean ridge systems. The source of hotspot lavas has been shown to contain recycled, subducted materials but also primitive material as seen from noble gases isotopic compositions. Water contents are higher in OIBs than in MORB but due to divergent H_2O/Ce and δD measured on different hotspots, there is presently no consensus on either the origin of water in hotspot lavas or even if there still is juvenile water in their sources. Lavas from Loihi seamount and Pitcairn both contain EM-1-type material and have primitive neon isotopic compositions, pointing at a mixing between recycled and primitive components in the mantle, and making the comparison of H systematics between the two hotspots key to shed light on the potential existence of primitive water. 7 samples from Loihi and 17 from the active zone of the Pitcairn hotspot were analysed in this study. Water concentrations measured by manometry range from 0.4 to 0.9% for Loihi and 0.5 to 1.2% for Pitcairn, while δD range respectively from -72 to -65‰ and -53 to -36‰. All but one sample from Loihi are unaffected by degassing, and the H_2O content variations are mainly due to variations of partial melting and crystal fractionnation. The δD of the 6 other samples are very homogenenous (-67.9±1.5‰). For the Pitcairn samples, initial water concentrations and isotopic compositions are calculated using the concentrations and δD of water in the vesicles, assuming closed-system degassing for water.

In Pitcairn samples, the results are compatible with a two-components mixing, one D- (δD>-40‰) and water-rich (H_2O/Ce>150), and the other D- (δD<-45‰) and water-poor (H_2O/Ce<125). The water-rich samples are also those richest in incompatible trace elements. Previous studies [1,2] have shown that in samples from Pitcairn, the ones most affected by the EM-1 component have primitive neon isotopic composition and are also richer in incompatible elements. The contrasted δD between the two hot-spots suggests that the component bearing primitive Ne is water-poor, and, thus, that water in Pitcairn comes from recycling processes.

[1] Honda and Woodhead (2005), *EPSL* **236**, 597-612 [3] Eisele *et al* (2002), *EPSL* **196**, 197-212.