Deep fast-spread Oceanic Crust - Fluid Interactions: Petrography and Volatiles from IODP Expedition 345 Hess Deep Plutonic Crust

R. MEYER[1], R.P. WINTSCH[2], T. NOZAKA[3], K. M. GILLIS[4], J.E. SNOW[5], AND IODP EXPEDITION 345 SHIPBOARD SCIENTIFIC PARTY

[1] University of Bergen, Norway; Romain.Meyer@geo.uib.no
[2] Indiana University, Bloomington IN, USA
[3] Okayama University, Japan
[4] University of Victoria, B.C., Canada
[5] University of Houston, Houston TX, USA

IODP Expedition 345 returned to the Hess Deep Rift almost exactly 20 years after ODP Leg 147. Here we report preliminary results of the recent expedition (Dec. 2012 - Feb. 2013) in the Eastern Pacific Ocean. The Hess Deep Rift exposes a dismembered, but nearly complete lower crustal section of fast-spread East Pacific Rise (EPR) plutonic crust. Recovered core includes high Mg# (79-89) olivine gabbros, gabbros, gabbronorites and troctolites. Due to the scarcity of in-situ rocks from these depths alteration processes within such deep parts of the oceanic crust are still ambiguous. However, such data are essential to better understand global crustal mass balance, tectonics, hydrothermal processes, and cast light on deep crustal biosphere conditions. Shipboard petrography has revealed that high-temperature tremolite-chlorite replacement of olivine + plagioclase is less abundant at deeper levels, in contrast to the dominance of background greenschist/subgreenschist-facies serpentinisation of olivine in addition to prehnite +/- chlorite formation after plagioclase. Shipboard C, H and S measurements define H_2O as major volatile component (0.95 – 9.57 wt.%) in the sampled plutonic rocks. Water abundance within these rocks correlates with the degree of alteration, Ni, and modal olivine contents. The H_2O/MgO ratio of the troctolites (0.31) is consistent with that of serpentine (0.32) and indicates the importance of serpentinisation within the sampled lowest EPR oceanic crust. Localized low-temperature alteration is possibly due to Cocos-Nazca rifting associated with cataclastic deformation.

Glaciers and floodplains controls on weathering fluxes deciphered from two glacial-interglacial Nd isotopes records on both sides of New Zealand

LAURE MEYNADIER[1], ANTOINE COGEZ[1] AND CLAUDE ALLÈGRE[1]

[1]Equipe de Géochimie et Cosmochimie, Institut de Physique du Globe de Paris – Sorbonne Paris Cité, UMR 7154, Université Paris Diderot

A wide variety of climatic, tectonic or chemical factors can influence weathering intensity and/or fluxes. The interest of studying time series relies on the fact that some of these parameters varied through time and other remained constant : it is then possible to unravel informations “all other things being equal” about controls on weathering mechanisms.

We studied Nd isotopes (ε_{Nd}) in two DSDP sites (593 and 594) both in the detrital and authigenic fractions. These sites were collected on the large continental shelf, on both western and eastern side of New Zealand. The sediment covers the last 3 glacial-interglacial cycles (300 kyrs). The interest of this area is linked to the rather uniform lithology, and to the contrasts between the western and the eastern sides of NZ, introduced by the Alpin Chain topography. The Main Divide of the Alpin Chain separates the eastern side with steep slopes and high pluviometry, and the western side with small floodplains and lower pluviometry. In addition climatic forcing factors, such as the glacier extent, did vary through the glacial to interglacial periods.

Our results show ε_{Nd} variations in phase with the climatic fluctuations on both cores, but with a much lower amplitudes on the western core than on the eastern one. Given the various paleoceanographic informations available in the area we are able to demonstrate that the ε_{Nd} signal can not be explained by variations of the mixing contributions of the different ocean masses surrounding New Zealand. The ε_{Nd} signal has clearly a continental and local origin.

Using mixing calculations we show that the weathering Nd fluxes could have been up to 2 to 3 times higher during glacials than during interglacials. This result is explained by the control of glacial erosion that deliver higher amount of fine and fresh materials, easily weatherable. Moreover the lower amplitude of the variations on the western site suggests that floodplains play a key role in the chemical maturation of these fresh and fine grounded minerals delivered from the higher relief. Finally the relationship between our ε_{Nd} record and the $\delta^{18}O$ record suggest a non linear response (hysteresis like relation) of the erosion and weathering processes to climatic forcings.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.13