Massive H_2S release to surface waters at the Precambrian-Cambrian (PC-C) boundary: Evidence from Mo isotopes

MARTIN WILLE[1], THOMAS F. NÄGLER[1], STEFAN SCHRÖDER[2], BERND LEHMANN[3] AND JAN D. KRAMERS[1]

[1]Institute for Geological Sciences, University of Bern, Switzerland, (wille@geo.unibe.ch)

[2]Department of Geology, University of Johannesburg, South Afrika

[3]Insitute of Mineralogy, Technical university of Clausthal, Germany, (lehmann@min.tu-clausthal.de)

The geological and geochemical circumstances which have caused a decline in abundance and diversity of the soft-body Ediacara fauna at the end of the Precambrian followed by the “Cambrian explosion”, is still a question of debate. Several triggers and associated kill mechnism could have been responsible for the sharp extinction at the PC-C boundary. Besides a bolide impact, flood basalt eruptions and methane release, shallow water euxinia caused by upwelling of euxcinic bottom waters could provide an explanation for this biotic crisis. Further it is known that changing redox conditions like an increase in atmospheric oxygen concentrations could have played a key role for the Cambrian explosion. It was proposed that during the late Neoproterozoic period, elevated free oxygen concentrations could have triggered the evolution of eukaryotic organism (Fike *et al*. 2006). Therefore it seems to be reasonable, that changing redox conditions could have also been responsible for the evolutionary changes in early Cambrian times.

To check this hypotheses we present Mo isotope signatures in black shales from two sample sets (Ara group, Oman and Yangsee Platform, China) which were deposited at and shorty after the PC-C boundary.

At the first view, the overall Mo isotopic signature of the early Cambrian black shales from Oman and China are similar to the signature found in Mesoproterozoic shales (Arnold *et al*. 2004). Canfield (1998) proposed that the Paleoproterozoic and Mesoproterozoic ocean was strongly chemically stratified with sulfidic deep deep waters and modestly oxygenated surface waters. Our new early Cambrian data support the idea that this stratification might have continued untill the end of the Proterozoic.

On an closer inspection, a transient Mo isotopic signal following immediately after the PC-C boundary in both sample sets indicates a short but intense global non-steady state situation. Combined with the extreme Mo enrichment, found in the Chinese sulfide marker bed at the PC-C boundary, this signal can not be explained with recent Mo scavenging mechanism known from recent oceans. We put forward the working hypothesis of an upwelling of euxinic bottom water masses of an chemically stratified ocean as explanation for this Mo anomalies. This scenario not only explains the transient isotopic signal and the metal enrichment found at the PC-C boundary in several localities, it can also be responsible for the sudden extinction of the Ediacarian fauna caused by H_2S poisoning.

Low-latitude calibrations of terrestrial cosmogenic nuclide production rates

A. J. WILLIAMS, R. PIK AND P. G. BURNARD

CRPG-CNRS, 15 rue Notre Dame des Pauvres, 54501Vandoeuvre-les-Nancy, France (alicejw@crpg.cnrs-nancy.fr; rpik@crpg.cnrs-nancy.fr; peteb@crpg.cnrs-nancy.fr)

The scaling factors used for correcting production rates of terrestrial cosmogenic nuclides (TCN) for the effects of atmospheric absorption and the geomagnetic field on the cosmic ray flux, remain the largest source of uncertainty in determinations of surface exposure ages and erosion rates using the TCN technique. In the framework of the CRONUS-EU Marie Curie research training network, established to refine scaling factors and production rates, we have targeted basaltic lava flows at low latitude (where the effects of the geomagnetic field are assumed to be greatest) for natural calibration of cosmogenic ^{3}He, ^{21}Ne and ^{36}Cl production rates. Sampling conducted over altitude transects permits quantification of atmospheric effects.

The first locality sampled was 6000m-high Mt. Kilimanjaro, Tanzania (03°S). Young (50 ka?) olivine- and pyroxene-bearing flows were sampled in an "elevation window" defined by the upper limit of rainforest and the lower limit of Quaternary glacial activity. Additional samples were collected from older (c. 500 ka?) cones at low elevation in nearby localities and, for relative calibrations of TCN prodcution rates (e.g. $^{3}He/^{36}Cl$), from glaciated surfaces at high elevations. Initial results yield cosmogenic ^{3}He concentrations of $6.56 \pm 0.21 \times 10^{7}$ at/g (2750m) to $11.06 \pm 0.46 \times 10^{7}$ at/g (3300 m), consistent with exposure ages of c. 150 ka for these contemporary flows if calculated using published production rates and scaling factors. Negligible variation in measurements of multiple samples (< 5% uncertainity) supports preservation of original flow-top features and the absence of post-eruptive erosion or burial of flows. Independent age determinations of these samples using Ar/Ar dating are on-going.

Recent investigation has moved to the Afar region of Ethiopia (12°N). Preliminary sampling has entailed collection of multiple samples over a 350 m altitude transect of a single flow on Beddi volcano in the Dabbahu rift-segment. The initial cosmogenic ^{3}He measurements will assess our ability to perform high-sensitivity altitude calibrations.

Along with localities targeted by other teams in the CRONUS-EU network (Ascension Is. 07°N, Univ. Edinburgh and Cape Verde Is., 14°N, Univ. Glasgow) the Kilimanjaro and Ethiopia localities comprise the lowest latitude calibrations performed to date.