Cadmium isotopes in northeast Pacific Ocean seawater

C.M. ZURBRICK[1,*], D. BILLER[2], C. HARRIS[3], M. REHKÄMPER[4], K.W. BRULAND[2,5], A.R. FLEGAL[1,5]

[1]Department of Microbiology and Environmental Toxicology, UC Santa Cruz, Santa Cruz, USA, CZurbric@ucsc.edu (* presenting author)

[2]Department of Ocean Sciences, UC Santa Cruz, Santa Cruz, USA, DBiller@ucsc.edu, Bruland@ucsc.edu

[3]Stanford University, Palo Alto, USA, CHarris2@stanford.edu

[4]Imperial College, London, United Kingdom, MarkRehk@imperial.ac.uk

[5]Institute of Marine Sciences, UC Santa Cruz, Santa Cruz, USA, Flegal@ucsc.edu

Background

Seawater was collected from the California Current Upwelling Zone in the northeast Pacific to investigate factors influencing cadmium concentrations and isotopic compositions in that dynamic region. As expected, cadmium and nutrient (phosphate, nitrate) concentrations were highly correlated both (i) in the cores of intense upwelling eddies and (ii) in relaxed and downwelling eddies [1]. Cadmium isotopic composition of those waters and associated plankton were then compared to test the hypothesis that primary productivity accounts for the relative depletion of lighter cadmium isotopes in surface seawater [2]. Cadmium isotopes in seawater were also compared with iron and zinc concentration data to further resolve factors contributing to the cadmium isotope depletion in surface waters.

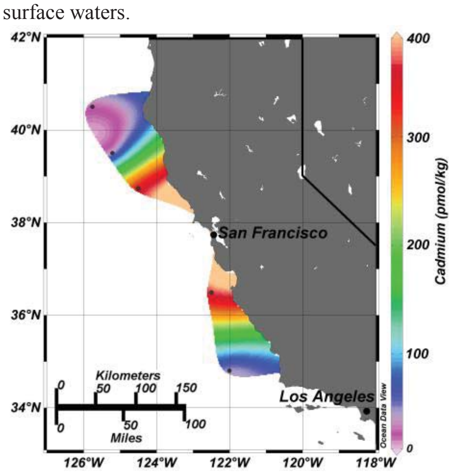

Figure 1: Cadmium concentration (pmol/kg) in the surface waters of the California Current Upwelling Zone.

Preliminary Results

Preliminary results show that freshly upwelled waters have similar cadmium isotopic signatures as deep waters. Nutrient rich waters that had large phytoplankton blooms with subsequent nutrient drawdown showed isotopic fractionation consistent with previous hypotheses [2, 3] and correlate with Fe and Zn data.

[1] Bruland *et al.* (1978) *Limnol. Oceanogr.* **23**, 618-625.
[2] Ripperger *et al.* (2007) *EPSL* **261**, 670-684.
[3] Abouchami *et al.* (2011) *EPSL* **305**, 83-91.

Brittle fault dating from the Mesoproterozoic to the Neogene

HORST ZWINGMANN[1]*, NEIL MANCKTELOW[2], GIULIO VIOLA[3] JAN PLEUGER[2], SEIKO YAMASAKI[4] AND TAKAHIRO TAGAMI[5]

[1]CSIRO ESRE, Perth, Australia, horst.zwingmann@csiro.au (* presenting author)

[2]ETH Zuerich, Switzerland, neil.mancktelow@erdw.ethz.ch

[3]NGU, Trondheim, Norway, giulio.viola@ngu.no

[2]ETH Zuerich, Switzerland, jan.pleuger@erdw.ethz.ch

[4]JAEA, Gifu, Japan, yamasaki.seiko@jaea.go.jp

[5]KUEPS Kyoto University, Japan, tagami@kueps.kyoto-u.ac.jp

Over the last decade constraining the timeframe of brittle faulting has been applied successfully in many case studies. We present fault gouge illite age data from several studies in the European Alps, Finland and Japan. All studies deal with igneous or metamorphic rocks collected from tunnel or drill core samples, which offer a unique advantage as no detrital illite is present in the host rock, thus reducing potential contamination and weathering sources. The age data were obtained using a simplified and standarized method described by Zwingmann et al. (2010). Illite ages range from the Mesoproterozoic (1240±26 Ma) for the Finland samples to the Neogene (6.0±2.1 Ma) for the European Alps study.

For the European Alps study, samples were collected from the AlpTransit tunnel and the K-Ar ages for illite fractions range between 9.5 and 3.9 Ma.

The remarkable dating of Mesoproterozoic and Neoproterozoic ages for the Finnish brittle faults proves the potential of the technique also in the case of extremely old cratonic terranes and their faulting histories. In addition, the preservation of both Meso- and Neoproterozoic isotopic signatures within one single fault core and the geologically meaningful dating of two coexisting but texturally different gouges of different age document a rare case of age determination of a faulting episode and of a subsequent reactivation in the brittle realm.

Within the Japan case study, gouge samples were investigated from a subsurface fault collected within a shaft in the Cretaceous Toki granite. The K-Ar ages of the fractions with no detectable contamination from detrital K-bearing minerals range from 53 to 43 Ma.

In all case studies the illite ages generally decrease with grain size, and they are consistent with the cooling history of the host rocks as bracketed by AFTA and ZFTA ages. The data indicate that that the fault-rock samples formed within the stability field of illite and the main temperature field of brittle deformation (<300°C). The internal consistency of the K-Ar ages of fault gouges from both surface and subsurface samples, as well as their consistency with constraints from field relationships and existing geochronological data demonstrate the potential of this simplified method for providing new data to constraint absolute timing of brittle deformation.

[1] Zwingmann et al. (2010) *Geology* 38, 6, 487-490; doi10.1130/G30785.1