Possible link between CO_2 degassing and climate change in SW Turkey

E. ÜNAL-İMER[1]*, I.T. UYSAL[1], J. SHULMEISTER[1] AND J.X. ZHAO[1]

[1]The University of Queensland, Brisbane, QLD, 4072, AUSTRALIA (*correspondence: e.unal@uq.edu.au)

High-pressure CO_2-rich fluids can trigger fault activity by reducing the shear stress [1]. Subsurface meteoric water at crustal depths of 10–15 km, mainly contributed by local rainfall sourced groundwater, may be the major fluid source in large-scale continental extensional areas [2]. Carbonate vein deposits could precipitate from such CO_2-rich, deeply circulated overpressurised meteoric water within intensely-fractured/faulted rocks along active normal fault zones, within a rapidly extending region in SW Turkey [3,4,5] sub-samples of such vein calcites were investigated by advanced U-series dating and O-isotope analyses. The U-series ages show that calcite vein formations occurred largely during lower solar insolation (summer) periods in the Late Pleistocene in this region. These are interpreted as the periods of elevated effective precipitation, which could be responsible for fluid overpressures achieved by either increasing absolute or seasonal precipitation or by reducing evapotranspiration. Although full glacial periods are commonly associated with dry climatic conditions, regional conditions can vary. We suggest that the Eastern Mediterrenean basin including Turkey was relatively wet under low to transitional insolation regimes, specifically, during the Last Glacial Maximum. This is likely a response to southerly-shifted westerly wind flow in the Northern Hemisphere bringing moisture supply over the study area. Further, the trend of $\delta^{18}O$ values plotted against U-series ages of vein calcites demonstrate possible responses to either climate variability or seismicity-related fluid exchange mechanisms on mm scale.

It is possible to correlate fault activity recorded by co-seismic vein calcites as a product of CO_2 degassing and local climate controlling the effective precipitation. This means that seismic hazard can be linked to changing climatic conditions in the region. Consequently, earthquake clusters in SW Turkey may be considered to be climate-related and a function of the increased availability of fluids during cool to cold climate periods.

[1] Hickman *et al*. (1995) *J. Geophys. Res.* **100**, 12,812–12,831. [2] Wickham *et al*. (1993) *Geology* **21**, 81–84. [3] Uysal *et al*. (2009) *Chem. Geol.* **265**, 442–454. [4] Uysal *et al*. (2011) *EPSL* **303**, 84–96. [5] De Filippis *et al*. (2012) *Geol. Soc. Am. Bull.* **124,** 1629–1645.

Microbial corrosion of steel in Toarcian argillite: Influence of metabolisms and biofilms

L. URIOS[1]*, A. PEREZ[4], C. WITTEBROODT[3], F. MERCIER[4], M. FLACHET[2], F. MARSAL[2], D. NEFF, M. MAGOT[1] AND P. DILLMANN[4]

[1]Université de Pau et des Pays de l'Adour, IPREM EEM UMR 5254, IBEAS, 64013 PAU, France, (*presenting author, laurent.urios@univ-pau.fr)

[2]IRSN, PRP-DGE/SEDRAN/BERIS, B.P. 17, 92262 Fontenay aux Roses Cedex, France (margot.flachet@irsn.fr)

[3]IRSN, PRP-DGE/SRTG/LETIS, B.P. 17, 92262 Fontenay aux Roses Cedex, France (charles.wittebroodt@irsn.fr)

[4]SIS2M/LAPA, CEA/CNRS UMR 3299, 91191 Gif-sur-Yvette Cedex, France (philippe.dillmann@cea.fr)

In the context of geological disposal of radioactive waste in clayey formations, the consequences of a microbial activity are of concern regarding the corrosion of metallic materials. Actually microbial life has been highlighted in argillaceous formations [1]. Sulfate- and iron-reducing bacteria, as well as bacteria able to develop at high temperatures have been detected in Tournemire[1] (Toarcian argillite) [2]. They can grow at the interfaces between steel and argillite in a short period compared with planned durations of disposal. Such bacteria may influence corrosion [3], that may cause a premature loss of containment of metallic barriers. The formation of biofilms may also lead to environmental modifications at the biofilm/metal interface that may further increase corrosion rates [4]. Thus, an experimental setup was designed to understand the conditions favoring the formation of biofilm and the impact of microorganisms on steel corrosion.

A synthetic solution representative of the Tournemire pore water percolated through cells containing steel coupons placed in contact with Tournemire argillite. Various environmental conditions likely to prevail in a repository were tested (anoxic or oxic conditions, 25°C or 50°C). A mix of strains able to form biofilms and sulfate- and iron-reducing bacteria, each present in Tournemire argillite, has been inoculated. Cells were dismantled after 1, 4 and 8 months to establish a chronology of the involved processes. Analyses of outgoing water chemistry provided indications on mechanisms occurring within the cells. Observations of the steel surface were made using Field Emission Scanning Electron Microscopy and Raman spectroscopy. Molecular characterization of the microbial diversity was used to determine which species are responsible for corrosion.

[1] IRSN's experimental platform

[1] Urios *et al*. (2012) *Appl. Geochem.* **27**, 1442-1450. [2] Urios *et al*. (2013) *Geomicrobiol. J.* **30**, 442-453. [3] Herrera & Videla (2009) *Int. Biodeter. Biodegrad.* **63,** 891-895. [4] Little *et al*. (1991) *Int. Mater. Rev.* **36**, 253-272.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.21