Continuous sampling of geothermal and groundwater volatiles in earthquake-prone regions

D.R. HILTON[1*], P.H. BARRY[2], C-C. FU[3], T.F. YANG[3] AND J.T. KULONGOSKI[4]

[1] Scripps Inst. Oceanography, UCSD, La Jolla, CA 92093, USA. (*correspondence: drhilton@ucsd.edu)

[2] Dept. Earth Sci., Univ. Oxford, Oxford OX1 3AN, UK.

[3] National University of Taiwan National Taiwan University, Taipei 10617, Taiwan.

[4] California Water Science Center, USGS, San Diego, CA 92101, USA.

Geochemical monitoring in earthquake-prone regions aims to document changes in volatile/chemical parameter(s) which either precede and/or result from seismic events. However, many monitoring programs in seismically-active areas (e.g., Long Valley Caldera, USA [1]; the North Anatolian Fault, Turkey [2]) have showed little or no changes in monitored species (e.g., $^3He/^4He$; $\delta^{13}C$) even over extended time periods. Whereas the magnitude of particular events and proximity to monitoring sites are key factors in generating anomalous chemical signals, high sampling frequency is also critical as it improves the likeihood of capturing transient signals induced by localised seismicity. To this end, we developed the continuous monitoring instrument, SPARTAH [3], to capture, store, and time-stamp groundwaters and geothermal fluids for periods of 6 months or more in a single deployment thereby preserving a time record in samples for laboratory analyses.

SPARTAH has been deployed on the San Jacinto Fault, California and at the Yun-shui (YS) monitoring station in central Taiwan producing a quasi-continuous record of He- and C-isotopes and associated concentrations. Both regions were characterised by significant seismic events (M = 4-5) over the SPARTAH deployment period allowing direct comparisons between the timing of events and variations in the volatile record. We discuss these temporal records which permit insight into how volatiles respond to discrete and sudden changes in the local crustal stress regime as well as the factors controlling the isotope and concentration characteristics of He and CO_2 in crustal aqueous fluids.

[1] Hilton (1996), *Chem. Geol.* **127**, 269-295; [2] de Leeuw et al. (2010), *Appd. Geochem.*, **25**, 524-539; [3] Barry et al. (2009), *G-cubed* **10**, doi: 10.1029/2009GC002422.