Sr isotopic evidence for dissolution of anhydrite in hydrothermal fluids at 9°50'N East Pacific Rise

J.M. McDermott*, K.L. Von Damm,
L. Kalnejais and J.G. Bryce

Department of Earth Sciences, University of New Hampshire, Durham, NH 03824
(*correspondence: jill.mcdermott@unh.edu)

Low-temperature hydrothermal fluids, long considered to be simple binary mixtures of high-temperature fluids and seawater [1], impact ocean chemistry and support thriving ecosystems at mid-ocean ridges (MORs). Low-temperature fluid composition, however, may be controlled by other processes in addition to simple mixing, in particular the dissolution of anhydrite. 9°50'N EPR contains high-temperature vents (Ty and Io) associated with low-temperature venting (BM82) for over a decade, thus providing an opportunity to constrain anhydrite contributions to fluids over time. The Sr isotope systematics of adjacent high- and low-temperature fluids will support either a binary seawater-hydrothermal mixture, or will support additional components. We have determined via thermal ionization mass spectrometry the Sr isotopic composition of fluids sampled in 1995 to 2007. Preliminary $^{87}Sr/^{86}Sr$ ranges are 0.704136±6 to 0.709037±5 in Io fluids and 0.709019±3 to 0.709171±5 in associated BM82 fluids. Pre-2005-eruption Io end member $^{87}Sr/^{86}Sr$ aligns with previous EPR studies [2] while immediate post-2005-eruption Io end member $^{87}Sr/^{86}Sr$ is closer to the seawater value. These results imply that immediate post-eruption water-rock reactions do not achieve the same degree of isotopic equilibrium as reactions during more stable periods [3,4]. Additionally, mass balance calculations indicate that BM82 fluids are not a binary seawater-hydrothermal mixture. Mixing models, based on EPR fluid chemistry and TAG anhydrite data [5], indicate that anhydrite dissolution may contribute up to 12% of low-temperature fluid Sr, relative to a 3% high-temperature and 84% seawater contribution. Our findings demonstrate that MOR hydrothermal anhydrite deposits may be a temporary sink for Ca, Sr, and SO_4, and that the hydrothermal flux component of these elemental budgets must be reinterpreted.

[1] Edmond *et al*. (1979), *Earth Planet Sci. Lett.* **46** 1-30. [2] Ravizza *et al*. (2001), *Geochim. Cosmochim. Acta* **65** 729-739. [3] Butterfield *et al*. (1997), *Phil. Trans. Royal Soc. London* **355** 369-386. [4] Von Damm (2000), *J. Geophys. Res.* **105** 11203-11222. [5] Mills *et al*. (1998), *Proceedings of the ODP* **158** 119-127.

The stomatal-CO_2 proxy: Limitations and advances

J.C. McElwain and D.M. Haworth

University College Dublin, Belfield, Dublin 4, Ireland
(jennifer.mcelwain@ucd.ie.)

The stomatal proxy method has emerged as a powerful tool of determining palaeo-atmospheric carbon dioxide concentration over the past decade. Advances in molecular biology have shown that stomatal frequency adjustments on the leaf surface in response to CO_2 concentration are under genetic control and elegant ecophysiological experiments have elucidated that mature leaves 'sense' ambient CO_2 concentration and signal to developing leaves to optimize stomatal frequency. Key limitations have also been identified. These include an apparent saturation of the stomatal frequency response of many plant taxa to current ambient CO_2 concentrations (>360 ppmV), the difficulty of calibrating stomatal frequency trends/responses of extinct taxa and a general paucity of studies documenting ecosystem-level responses of stomatal frequency to CO_2. Furthermore, many stomatal-proxy based CO_2 reconstructions have focused on times in Earth history which are characterized by catastrophic biological events such as mass extinctions and major origination events. The geological/astrological drivers of these major evolutionary events, such as the formation of Large Igneous Provinces, meteorite impacts, and initiation and termination of OAE's are likely to have significantly influences the atmospheric composition of sulphur dioxide in addition to CO_2, yet the influence of SO_2 on the fidelity of the stomatal CO_2 proxy has not been rigorously tested. We review the limitations of the stomatal proxy and offer possible solutions, and present preliminary experimental data on the response of stomatal frequency of analogue Mesozoic plant communities to combinations of elevated CO_2, SO_2 and sub-ambient O_2.