Possible paleo-climatic record from fossil hydrothermal systems in the Ross Sea area, Antarctica

L. DALLAI[1] AND R. BURGESS[2]

[1]CNR, Institute of Earth Sciences and Resources, Pisa, Italy (dallai@igg.cnr.it)
[2]SEAES, University of Manchester, UK (ray.burgess@manchester.ac.uk)

During Cenozoic time, diffuse alkaline magmatism related to the rifting in the Ross Sea Embayment intruded the northeastern region of the Wilson Terrane, Antarctica. Plutons with syenitic-monzonitic to gabbroic compositions provided the necessary heat source for local hydrothermal systems to occur in fractured rocks.

Oxygen and hydrogen isotope investigation of altered granitoids along the Ross Sea coastline were undertaken to constrain the characteristics of Eocene fossil hydrothermal systems. These were combined with Ar-Ar ages of the intrusions to provide a temporal framework for interpreting isotopic data. .$\delta^{18}O$ values, as low as 4 ‰ in K-feldspar of country rocks, and δD values of biotite/amphibole in the range of -100 ‰ to -200 ‰, indicate that these minerals interacted with meteoric-dominated hydrothermal waters.

Altitude, latitude, local climate conditions and tectono-thermal histories were considered similar for all the outcrops; thus the hydrogen isotope composition of hydrothermal minerals was used as a proxy for paleo-climatic reconstructions, provided the water-vapor hydrogen fractionation in the atmosphere is temperature-dependent.

By combining δD values of the hydrothermal waters with Ar-Ar ages, the isotopic compositions for meteoric recharge waters could be calculated for a fairly continuous time interval between 52 and 26 Ma.. This low resolution palaeo-climate curve shows several similarities to the high-resolution curve defining the global variation in $\delta^{18}O$ of seawater (Lear *et al*., 2000). In particular, the lowermost δD values (‰) corresond with positive shifts of the $\delta^{18}O_w$ curve occurring at -108 (50.6 Ma) to -152 (34.7 Ma and -156 (28.9 Ma). Our data therefore suggest that glacial events occurred after the Paleocene-Eocene Thermal Maximum, and well before the Eocene-Oligocene icehouse transition.

The estimated surface temperatures at the time of hydrothermal circulation vary between -1 to -10°C, similar to the modern temperature range measured along the Ross Sea coast. Thus, the δD-age curve may provide a proxy based on continental records for palaeo-environmental reconstruction in the southern sector of Antarctica.

References

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Zircon growth and resorption in an incrementally filled granite pluton: Insights from *in situ* U-Pb, trace element and Hf isotopic analyses

J. STEPHEN DALY [1], DAMIEN GAGNEVIN [1] AND MARTIN J. WHITEHOUSE [2]

[1]UCD School of Geological Sciences, Belfield, Dublin 4, Ireland (stephen.daly@ucd.ie, damien.gagnevin@ucd.ie)
[2]Laboratory for Isotope Geology, Swedish Museum of Natural History, Stockholm, Sweden (martin.whitehouse@nrm.se)

High uranium contents and lack of radiation damage due to its young age, permit high precision U-Pb zircon dating of the Monte Capanne monzogranite (Elba, Italy), one of the youngest granitic plutons exposed on Earth. The results are consistent with field relationships and indicate that the last zircon growth increment ranges from 7.85 ± 0.11 Ma in a mafic microgranular enclave (MME) to 7.27 ± 0.15 Ma in a mafic (Orano) dyke of similar monzogranitic to granodioritic composition. The spatial distribution of ages is consistent with incremental intrusion of the three petrographically-defined facies of the pluton (Dini *et al.* 2002). The San Marino porphyry (7.84 ± 0.14 Ma) was immediately succeeded by the San Francesco facies (7.76 ± 0.17 Ma) while the San Piero (7.53 ± 0.07 Ma) and Sant'Andrea facies crystallized later (7.57 ± 0.46 Ma) before the Orano dykes (7.27 ± 0.15 Ma). Importantly each component of the pluton displays a range of magmatic zircon ages spanning up to two million years, tentatively interpreted as dating the duration of magmatism. Much older inherited zircons occur, particularly in the San Francesco facies. These range in age from Archaean to Mesozoic and are interpreted as being derived from the source or wall rocks. Petrographically and in their trace element and Hf isotopic signatures, the zircons record repeated episodes of growth, partial resorption and regrowth, interpreted as evidence of iterative magma mixing and recharge (Gagnevin *et al*., 2007) consistent with previous models for the evolution of the Monte Capanne pluton derived from chemical and isotopic zoning in K-feldspar megacrysts (Gagnevin *et al*., 2005a, b) as well as whole-rock geochemical studies(Gagnevin *et al*., 2004).

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