Textural diagnosis of zircon re-equilibration by fluids and melts during high-*T* metamorphism

D.J. DUNKLEY

National Institute of Polar Research, Tachikawa, Tokyo 190-8518, Japan (danield@nipr.ac.jp)

Chemical re-equilibration of zircon during metamorphism occurs *via* both solid-state replacement and overgrowth. Zircon textures typical of solid-state modification by hydrous fluids are recognised from experiment and lower-*T* metamorphic scenarios, as a result of two processes [1]. Diffusion-reaction (DR), involving partial decomposition of metamict zircon by Ca-Cl-bearing or other hydrous fluids, can be diagnosed from Ca enrichment, lowered backscattered electron response, and preservation of primary structures. Coupled dissolution-reprecipitation (CDP), involving re-equilibration of zircon with fluid or melt, can be diagnosed from reaction fronts with modified U, Th, Y and/or HREE contents, plus pores and inclusions rich in elements ejected from primary zircon (*e.g.* xenotime, thorite, uraninite). During high-*T* (>700°C) metamorphism, modification can be mediated by hydrous fluids or anatectic melts, but their specifc roles can be ambiguous; especially in migmatites, where both agents are likely to be involved. Here, case studies are presented for which the role of fluids can be demonstrated, to help establish links between reaction textures and agents.

CASE 1: in granulite-grade dolomitic marbles, relics of felsic dykes were scapolitised by Cl-rich brines. U-rich magmatic zircon was altered by DR (with Ca, Cl, LREE and Eu-enrichment) and re-equilibrated by CDP (lobate domains depleted in U, with inclusions of uraninite). U-Pb dating resolves two episodes of fluid activity, in contrast to zircon in migmatites from the same locality, which yield a continuum of age estimates. **CASE 2:** zircon grains associated with ilmenite+apatite in metasomatised corundum gneiss preserve porous CDP-fronts with elevated U, Y and Yb, and low-U overgrowths resulting from Ostwald ripening. **CASE 3:** a Miocene oceanic core complex includes Fe-Ti gabbros that were hydrated at and below 800°C. Magmatic zircon with quench-derived (*e.g.* dendritic) morphologies contain Th+U+Y-rich cores, which were re-equilibrated by CDP into zircon with abundant pores and inclusions of xenotime, thorite and apatite. Re-equilibrated, low U+Th zircon is younger than unmodified zircon by less than 1m. y. DR textures are absent, as expected for non-metamict zircon.

[1] Geisler *et al.* (2007) *Elements* **3**, 43–50.

Ultra high-resolution elemental XRF scanning analysis of Santa Barbara Basin

L. DUNN AND I.L. HENDY

Department of Geological Sciences, The University of Michigan, 2534 C. C. Little Building, 1100 North University Ave, Ann Arbor, MI, 48109, USA (lardun@umich.edu, and ihendy@umich.edu)

The anoxic environment of Santa Barbara Basin (SBB), coupled with the extremely high sedimentation rate, high biological productivity, and confluence of surface currents make SBB a classic setting for studying paleoclimate. The basin is well known for its response to millennial scale climate changes, but reconstructing annual resolution in previous studies is limited to only the past few hundred years. Here we extend the annually resolved high-resolution paleoclimate record back 2000 years. Non-destructive elemental X-ray fluorescence spectrometry was conducted on the upper 45 cm of box core SPR0901-4BC and the upper 354 cm of jumbo piston core MV0811-14JC. Split cores were analyzed using the chromium tube of the ITRAX Model XRF Scanner. The chromium tube was selected as it yields greater sensitivity to silica and lighter elements; however, it excludes heavier elements such as iron, therefore resulting in a more limited array of overall elements analyzed. Count rate profiles were generated for aluminum, silica, sulfur, chlorine, argon, potassium, calcium, and titanium at 200μm (micron) intervals. After instantaneous sedimentation events, such as turbidites and flood sequences, were omitted and depth was corrected, we examined individual laminations, marked by increases in titanium, which are inversely correlated to changes in the other productivity driven elements. We interpret titanium concentrations to correspond to non-biogenic sediment, while the excess silica to titanium ratio is a record of biogenic material delivered by siliceous organisms such as diatoms. Excess calcium to titanium analysis is interpreted as calcium carbonate producing organisms such as foraminifera. The data will be used to reconstruct interannual and decadal oscillations in environmental conditions. Interannual variability such as El Nino Southern Oscillation (ENSO) events correspond with reduced upwelling and heavier rainfall, which cause a decrease in productivity and therefore yield higher relative titanium concentrations. Similarly, decadal trends such as Pacific Decadal Oscillation (PDO) events, when positive, also reduce upwelling conditions and cool the surface waters along the Western margin of North America, resulting in increased titanium counts. Assuming these are annual shifts, we can now produce an ultra high-resolution elemental record of biogenic productivity and precipitation record for the past ~2000 years.