Direct measurement of Ce^{3+}/Ce^{4+} and Eu^{2+}/Eu^{3+} in Hadean zircons by XANES

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Normalized REE profiles in zircon, ancient or modern, have been used as an indicator of environmental conditions. In this regard, excursions from an otherwise smooth trend among the lanthanides (i.e. positive Ce anomalies and negative Eu anomalies) are thought to be related to changes in valence ratios in response to the intrinsic oxygen fugacity of the system in which the host zircon crystallized. REE partitioning systematics and the magnitude of anomalies are generally not considered in conjunction with direct measurement of valence ratios of Ce or Eu within zircon, which requires very specialized instrumental capability.

We present Ce L_{III}-edge and Eu L_{III}-edge XANES spectra from ancient Jack Hills and Acasta Gneiss zircon grains. These analyses represent the first attempt to directly constrain valence in ancient grains, where trace element concentrations can be as low as 2 ppm for Eu and 7 ppm for Ce. Jack Hills grains studied here (4.0-4.1 Ga), show distinct positive Ce anomalies but indicate only minimal Ce^{4+} in XANES (<20%). Zircon grains from the Acasta Gneiss (3.6-3.9 Ga), by contrast, show domains with variable Ce^{4+} content (40-100%). The variable valence ratios of the two populations, by virtue of not being dominated by a single species, suggests that no dominant process resets valence over geological timescales and that considerable information may be obtained from a combined study of REE profiles and associated valence speciation in zircon.

Intracrystal microstructures in alkali feldspars from apparently fluid deficient felsic granulites: A chemical and TEM study

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Samples of apparently ‘dry’ high-pressure felsic granulites from the Bohemian Massif (Variscan belt of Central Europe) contain large perthites with several generations of exsolution features. The contacts between the orthoclase-rich host and the plagioclase precipitates of the first generation and the contact between the orthoclase-rich host and large kyanite, quartz and garnet inclusions is lined with a thin rim of albite This albite was formed at a late stage of the petrogenetic history related to fluid infiltration and associated albitization. In the vicinity of the large inclusions the plagioclase precipitates of the first perthtite generation become significantly depleted and the perthite microstructure coarsens composed dominantly of tweed orthoclase.

The primary exsolutions probably formed by spinodal decomposition at around 850-900°C during the high pressure stage (16-18 kbar). The second generation of albite-rich precipitates was formed at around 600-500°C. TEM investigations revealed that the interfaces between the second generation plagioclase lamellae and the orthoclase rich host are coherent or semi coherent. The formation of albite linings at phase boundaries and of patch perthite produced incoherent interfaces. The patch perthites, albitization and secondary coarsening in the vicinity of large inclusions developed below 400°C contemporaneously with fluid infiltration in the course of deuteric alteration.