Fingerprinting fluid processes in the continental crust: An integrated approach using grain-scale Sr, C, O isotopes and REE geochemistry

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Grain to sub-grain scale strontium, oxygen, and carbon isotope studies in combination with the *insitu* trace and REE geochemistry of carbonates, scapolite and associated minerals in granulite grade marble horizons interlayered with metapelitic granulites from lower continental crust exposed in East Antarctica, helped in distinguishing the fluid-processes associated with the metamorphic evolution of the region. Consistently low oxygen isotope composition ($\delta^{18}O$ = 12‰) and unusually high strontium isotope compositions ($^{87}Sr/^{86}Sr_{(550Ma)}$ > 0.725) are characteristic of a dolomitic marble member, associated with metapelitic rocks having $^{87}Sr/^{86}Sr_{(550Ma)}$ up to 0.764. Besides, high Cl-content (> 0.5 afpu) observed in scapolite poikiloblasts in boudins along the contact zones between marble and metapelite confirm the activity of hyper-saline aqueous fluids [1] during early stages of metamorphism. However, some marble layers in the region have preserved "pre-metamorphic" oxygen isotopic composition ($\delta^{18}O$ = 18‰) and strontium isotope initial ratio ($^{87}Sr/^{86}Sr_{(550Ma)}$ = 0.707), suggesting a structural control on fluid movements in the lower crust.

LA-ICPMS studies on trace and rare earth elements on carbonate and associated silicate minerals in different textural settings, distinguished using cathodoluminescene microscopy, revealed multiple metasomatic events during retrograde metamorphism. Trace element contents of Ba, Sr, Pb and U gave compelling evidence for metasomatic alteration, which postdate the exsolution of carbonate at ~ 600ºC. Further, meteoric fluid infiltration that occurred at a shallower level of the crust caused extreme oxygen isotopic heterogeneity. Our results, thus, emphasize the importance of geochemical heterogeneities preserved in millimeter to micrometer scale in natural rocks that helps in portraying the fluid processes in the continental crust, based on which we understand its geodynamic evolution.

References

[1] Satish-Kumar, M., Hermann, J., Tsunogae, T. & Osanai, Y. 2006 *JMG,* **24,** 241-261.