European Mineralogical Conference
Vol. 1, EMC2012-288, 2012
European Mineralogical Conference 2012

Linking deformation in high grade metamorphic terrains with geochronology, a Lu-Hf garnet case study in Southern India′s Palghat Cauvery Suture Zone

N. Noack (1), R. Kleinschrodt (1), M. Kirchenbauer (1), R.O.C. Fonseca (2), and C. Münker (1)

(1) Institut für Geologie und Mineralogie, Universität zu Köln, Greinstr. 4-6, 50939 Köln, (2) Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Rheinische Friedrich-Wilhelms Universität Bonn, Poppelsdorfer Schloss, 53115 Bonn

Deciphering the timing of regional tectonic processes is an essential tool in evaluating the geological history of polyphase metamorphic terrains. In this context garnet is a key mineral for both the reconstruction of PT paths and for geochronological applications like the Sm-Nd and Lu-Hf chronometers. A particular application for Lu-Hf garnet chronometry in high-grade metamorphic assemblages arises from the fact that the closure temperature of Lu-Hf in garnet as well as the ductile high temperature deformation of the garnet lattice fall within the same temperature window of $\sim$ 700-900°C (Ji & Martignole 1994, Scherer et al. 2000).

Suture zones with relics of oceanic crust and regional shear zone tectonics provide vital information on the amalgamation history of former supercontinents. Here we combine Lu-Hf garnet chronometry with structural information on the Palghat Cauvery Suture Zone (PCSZ), in southern India. The PCSZ exhibits an arrangement of mafic seafloor relics and an intricate regional shear zone arrangement. In recent studies (Collins et al. 2007, Santosh et al. 2009) the PCSZ was interpreted as being part of the Neoproterozoic Mozambique Ocean suture of the Gondwana supercontinent. The Neoproterozoic timing of East Gondwana‘s amalgamation along this line is challenged by our findings.

Within the PCSZ the Kanjamalai Mafic Complex (KMC) (11.62°N 78.04°E) is one of the relics of former oceanic crust, metamorphosed at granulite facies conditions (8-12 kbar; $\sim$750°C). Metamorphic garnets in our samples were formed by net-transfer-reactions of plagioclase + clinopyroxene + orthopyroxene (+Fe-ore phases) producing variable amounts of garnet + quartz. Primary prograde zoning of major elements (Fe, Mg, Mn) in garnet was erased by internal diffusion during high temperature conditions while REE growth zonation remained unaffected. A three-point Lu-Hf garnet isochron of 2483 $\pm$ 29 Ma (MSWD=0.96) is interpreted as a metamorphic age in accordance with field observations and in situ mineral analyses.

The tectonic structure of KMC is a doubly plunging syncline located within one of the regional shear zones displaying higher strain rates and a contrasting steep lineation. With respect to the regional deformation that led to the formation of the KMC synform with elongated garnets parallel to the fold axis the high temperature equilibration of almandine garnets is clearly post deformational. Grain boundary configurations and internal deformation features were annealed during prevailing high temperatures while REE zonation persists. In such a case the Lu-Hf garnet metamorphic age clearly constrains the timing of the regional deformation.

We conclude that not only the emplacement and high grade metamorphism, but also the deformation of the suture zone rocks from KMC, can be confined to an Archean-Paleoproterozoic event. Our findings contrast with recent models for the closure of the Mozambique Ocean within east Gondwana amalgamation models.

REFERENCES

Collins et al., 2007. Terra Nova 19, 141–147.
Ji, S., Martignole, J., 1994. Journal of Structural Geology 16, 985-996.
Santosh et al., 2009. Gondwana Research 16, 321–341.
Scherer et al., 2000. Geochimica Cosmochimica Acta 64, 3413–3432.