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Raman spectroscopy of detrital garnet from the (U)HP terrane of eastern Papua New Guinea

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Garnet is one of the most widespread heavy minerals in sediments derived from orogenic systems. Its chemical composition varies systematically with temperature and pressure conditions, and thus provides information on the metamorphic evolution of source areas that is crucial in tectonic and geodynamic reconstructions. Garnet is easily identified in mineral grain mounts and is relatively stable during burial diagenesis. Raman spectroscopy allows rapid determination of garnet compositions in grain mounts or thin sections of sand and sandstone samples, and can be used to assess their density and chemical composition quite accurately ("MIRAGEM" method of Bersani et al., 2009; Andò et al., 2009).

In the D'Entrecastreaux Islands of southeastern Papua New Guinea, the world's youngest (U)HP rocks are exposed. There, mafic rocks and their felsic host gneisses were metamorphosed under eclogite facies conditions from late Miocene to Pliocene, before being exhumed from depths of ∼90 km (Baldwin et al., 2004, 2008). The eclogite preserves a peak assemblage of garnet, omphacite, rutile, phengite and Si02 (Hill and Baldwin, 1993). A coesite-eclogite has been found in one small island outcrop. In order to sample garnet populations representative of a larger geographical area, we sampled and studied a heavy-mineral-dominated placer sand (HMC 80) from a beach from SE Goodenough Island. Garnet grains in beach sand are associated with blue-green to subordinately green-brown amphibole and minor epidote, omphacitic clinopyroxene, titanite, apatite and rutile. The subordinate low-density fraction is feldspatho-quartzose with high-rank metamorphic rock fragments and biotite (Q62 F35 Lm2; MI 360). Detrital garnets are mostly classified as almandine with relatively high Mg and Ca and lacking Mn, typical of the eclogite facies (Win et al., 2007; type Ci garnets of Mange and Morton 2007; Andò et al., 2013).

In well-described stratigraphic sequences within syn-and post-tectonic basins adjacent to orogenic systems, Raman-assisted heavy-mineral studies allow us to detect the first arrival of eclogitic garnet, and thus to assess the minimum age of exhumation and final unroofing of high-pressure rocks (Malusà et al., 2011; Malusà and Garzanti, 2012). However, in the (U)HP terrane of southeastern Papua New Guinea, sediments derived from the actively exhuming D'Entrecasteaux Island core complexes are still being deposited offshore, are rarely preserved sub-aerially, and as such stratigraphic constraints are limited. Raman analysis of detrital garnets from placer sand thus provides invaluable constraints to compare with mineral assemblages preserved in exhumed eclogites.

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