World's oldest eclogites? Phase equilibria constraints on 2 Ga metapelitic-hosted eclogites from the Usagaran Orogen, Tanzania

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Eclogite-facies rocks preserve a record of deep crustal thickening and exhumation. Orogenic belts that contain eclogites generally mark plate collisions and are considered to represent ancient subduction zones. Eclogites from the Paleoproterozoic Usagaran Orogen, which flanks the eastern margin of the Archean Tanzania Craton, yield ages of 2 Ga and are considered to be the amongst the oldest preserved eclogites in the world.

Phase equilibria constraints indicate that metapelitic rocks, which structurally envelop eclogite-facies mafic rocks [1], developed a peak metamorphic assemblage of gt–ky–amph–mus–bi–ru–q at ~12 kbar and 650ºC; far lower pressures than previously predicted. Prograde chemical zoning preserved in garnet appears to mitigate against exhumation of the metapelites from eclogite facies conditions Rather, the petrological and compositional data suggest a steep up-pressure prograde path. Premlinary data suggests that the mafic eclogites underwent metamorphic reworking at around the conditions recorded by the peak assemblages in the enclosing metapelites. If this is correct is implies that the exhuming eclogites became structually mixed with metasedimetary lithologies located higher in the exhumation channel. Such a scenario is similar to that inferred in modern convergent margin settings, and implies that the Usagaran Orogen is one of the oldest examples of "modern style" plate margin metamorphism.

[1] Möller, Andreas, *et al*. "Evidence for a 2 Ga subduction zone: Eclogites in the Usagaran belt of Tanzania." *Geology* 23.12 (1995): 1067-1070.

Diamonds and their inclusions from Dachine, French Guiana: A record of Paleoproterozoic subduction

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Diamonds and their mineral inclusions provide a record of deep mantle processes. Most diamonds are from the sub-continental mantle lithosphere and record ancient episodes of growth, whereas others form at sub-lithospheric depths and record deep carbon cycling1. We report new data from a unique suite of diamonds and syngenetic inclusions from the Dachine ultramafic, French Guiana. These samples defy categorisation into traditional diamond groups, but show evidence of originating in a subduction zone environment.

The highly altered Dachine host rock (2.1 Ga) is not kimberlitic, but based on textures and chemical characteristics has been identified as a pyroclastic komatiite[2]. Dachine diamonds also have unique characteristics[3] including low N aggregation state (type Ib), a predominance of light C and heavy N isotopes, and complex internal morphologies often showing evidence of deformation. We have located five syngenetic garnet and Cpx inclusions, which are the first reported silicate inclusions in Dachine diamonds. The three garnet inclusions are eclogitic having high Ca and low Cr, and are unusually rich in Mn and Ni but extremely depleted in LIL and LREE. The Cpx inclusions are also extremely depleted in incompatible elements and one is Mn-rich.

The trace element systematics of the silicate inclusions are best matched if the inclusions represent residual phases to either multiple melt/fluid extraction events during subduction, or by a single extraction event involvimg coexisting trace phases such as epidote and rutile. Temperature constraints from N aggregation are inconsistent with a high-temperature komatiite origin for the Dachine host, whereas trace element systematics can be reconciled with a melt generated in a subduction zone environment, an origin which we presume is cold and hydrous. A model integrating all these observation suggests diamond and inclusion growth, and possibly host magma generation, at the interface between a Paleo-proterozoic subducting slab and overlying mantle.

[1]. Shirey et al (2013), *RIMG* 75, 355-421. [2]. Capdevila et al (1999), *Nature* 399, 456-458. [3]. Cartigny *et al* (2010) *EPSL* 296, 329-339.

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