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High Li abundances and heterogeneous Li-isotope and trace element compositions in ferropericlase inclusions in diamonds from Sao Luiz (Brazil) suggest an origin from a subduction melange

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The most remarkable feature of the inclusion suite in alluvial diamonds from Sao Luiz (Juina) is the enormous range in Mg-values (Mg#) of the ferropericlases. The Mg-richer members are part of the lower mantle suite when they coexist with either ringwoodite or Mg-Si-perovskite. This, however, is no explanation for the Fe-richer members and a lowermost mantle or a D" layer origin has been proposed. Such an ultra-deep origin singles the ferropericlase-bearing diamonds out from the rest of the Sao Luiz inclusion suite which is also dominated by Ca-rich phases and these are now thought to have an origin in the uppermost lower mantle and in the transition zone and to belong either to a peridotitic or mafic lithology (subducted oceanic crust).

We analyzed a new set of Fe-richer ferropericlase inclusions from 10 diamonds for their Li isotope composition by solution MC-ICP-MS, their major and minor elements by EPMA and their Li-contents by SIMS, with the aim to find supportive evidence for the origin of the ferropericlase protoliths.

Our new data confirm the huge range in Mg# known from the literature and augment the known incoherency between major and minor elements. Aggregated ferropericlase inclusions from four diamonds provided sufficient material to determine the Li isotope composition, which ranges from δ^7Li +9.6‰ to -3.9‰This range encompasses that of serpentinized ocean floor peridotites including rodingites and ophicarbonates, fresh and altered MORB, seafloor sediments and of eclogites. This overlap in isotopic composition and the variability in chemical composition, with an extreme and incoherent range in Mg# and Cr-, Ni-, Mn-, Na- and up to 5 times higher than 'primitive upper mantle' Li-abundances, suggests that the protoliths of the ferropericlase inclusions were members of these diverse lithologies. This melange of altered rocks originally contained a variety of carbonates (calcite, magnesite, dolomite, siderite) and brucite as secondary products in veins and as patches and Ca-rich members like rodingites and ophicarbonates. Dehydration and redox reactions during or after deep subduction into the transition zone and the upper parts of the lower mantle led to the formation of diamond and ferropericlases with variably compositions and the predominance of the Ca-rich, high-pressure silicate inclusions. These grew from peridotites, mafic rocks and as reaction and redox products between calcite and SiO_2.