Massive continental crust production and recycling during Hadean times: evidence from olivine-hosted melt inclusions from komatiites and implications for Hadean continental crust growth models.

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Résumé

The conditions of continental crust production during early Earth times (> 4.0 Ga) remain debated, with estimates for the fraction of continental crust formed at the Hadean-Archean transition ranging between 10% and 100% of the present-day continental crust volume (Korenaga, 2018). Besides, although it is clear from previous studies, e.g. those presenting 142Nddeviation from the Bulk-Silicate Earth (BSE),that crust was produced during the Hadean, the geochemical nature and fate of this Hadean crust is still poorly constrained. Here we present major, trace and Sr-isotope analyses of Sr-ultra depleted melt inclusions hosted in high-Mg (=Mg/Mg+Fe) olivine crystals from the *ca.* 3.27 Gyr Weltevreden komatiites (Connolly et al., 2011). Since the degree of melting require to form komatiitic melts is elevated ($\geq$ 40%, Herzberg, 1992), we use komatiitic melt inclusions to provide solid constraints onto the nature of the early mantle. To recognize and avoid the effect of secondary alteration that can compromise the interpretation of mobile elements such as H, Sr, Pb and U, all our analyses were obtained through spatially resolved protocols (EPMA, Raman and LASS).

In line with previous whole-rock scale isotopic studies of Weltevreden komatiites (Hf, Nd, see Puchtel et al., 2013) our results show a statistically heterogeneous population of Sr-isotope signatures in the 98 olivine-hosted melt inclusions analyzed. This heterogeneous population can be discriminated into three groups, including one of 10 inclusions showing Sr-model age of 4.3±0.2 Ga, indicating isolation of this mantle source from the BSE during the Hadean. This group of Hadean analyses also show elevated canonical ratios (Nb/U and Ce/Pb, see Hofmann et al., 2022) indicating both partial melting of hydrated oceanic crust and extraction of continental crust, before recycling into mantle, i.e. processes similar to those occurring in present-day subduction settings. Using the canonical values obtained in the Hadean melt inclusions, we estimate that more than 50% of the present-day continental crust volume was already formed by the end of the Hadean.

Our results unambiguously indicate significant continental crust formation and efficient recycling of during the Hadean.

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Mots-Clés: melt inclusion, komatiite, Sr, isotope, continental crust growth