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Anomalously low δ^{18}O – the first isotopic record of the oldest glaciation within the Belomorian terrain?

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Very low δ^{18}O values (-15 to -24‰oSMOW) were measured in the corundum-bearing mafic rocks hosted by the Achaean Chupa gneisses (+8 – 12‰) of the Belomorian terrain at Hetoostrov Is., North Karelia. These suggest interaction of the rocks or their precursors with extremely ^{18}O depleted fluid of meteoric origin at fluid-rock ratios > 2. Calculated δ^{18}O of the fluid (-20 to -35‰oSMOW or even less, depending on the temperature and fluid/rock ratio) requires several steps of evaporation-precipitation (Raleigh fractionation) under low temperatures of -15 to -35°C, estimated using Dansgaard (1964) T- δ^{18}O relationship as a proxy. This, in turn, implies glacial or inter-glacial palaeo-conditions within the Precambrian history of the Chupa suite.
A primary volcanic-sedimentary Chupa sequence (2.9 Ga) underwent two high-grade metamorphic events (granulite to amphibolite facies ca. 2.7 Ga and amphibolite to greenschist facies ca. 1.8 Ga). However, the meteoric fluid infiltration, or even recycling to achieve high fluid-rock ratios, down to the depths of 20 km or more during syn- or late- metamorphic processes is hardly possible. Post-metamorphic fluid-rock interaction as a cause of ^{18}O decrease cannot explain the lack of ^{18}O depletion in the surrounding Chupa gneisses. All our data are consistent with the premetamorphic ^{18}O depletion and, hence the premetamorphic origin of the meteoric fluid. The fluid generation could be roughly coeval or slightly predates the sedimentation of the Chupa suite after weathering of the source Karelian Craton.
The results might provide first evidences of ca. 2.9 Ga glaciation within the Belomorian terrain, which might be synchronous with the oldest recorded Mozaan Group glaciation (South Africa: Young et al., 1998).