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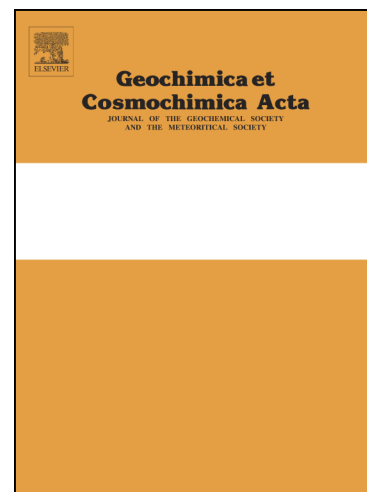
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Revision 2

Formation of abiotic hydrocarbon from reduction of carbonate in subduction zones: Constraints from petrological observation and experimental simulation

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## Abstract

Subduction is a key process for linking the carbon cycle between the Earth's surface and its interior. Knowing the carbonation and decarbonation processes in the subduction zone is essential for understanding the global deep carbon cycle. In particular, the potential role of hydrocarbon fluids in subduction zones is not well understood and has long been debated. Here we report graphite and light hydrocarbon-bearing inclusions in the carbonated eclogite from the Southwest (S.W.) Tianshan subduction zone, which is estimated to have originated at a depth of at least 80 kilometers. The formation of graphite and light hydrocarbon likely results from the reduction of carbonate under low oxygen fugacity ( $\sim$  FMQ - 2.5 log units). To better understand the origin of light hydrocarbons, we also investigated the reaction between iron-bearing carbonate and water under conditions relevant to subduction zone environments using large-volume high-pressure apparatus. Our high-pressure experiments provide additional constraints

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