TAO Renbiao, ZHANG Lifei, LIU Xi, Vincenzo STAGNO, LIU Jinzhong, FEI Yingwei, 2013. Subduction Factory: New Genesis of Abiotic Hydrocarbons and Diamond (Graphite) to the Upper Mantle. *Acta Geologica Sinica* (English Edition), 87(supp.): 269.

Subduction Factory: New Genesis of Abiotic Hydrocarbons and Diamond (Graphite) to the Upper Mantle

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We report the discovery of graphite-bearing fluid inclusions coexisting with ankerite and magnetite in carbonated eclogite from the low-temperature and ultrahigh-pressure oceanic subduction zone of Southwestern Tianshan, China. However, mechanisms and conditions permitting graphite precipitation from C-bearing fluids within subduction zone are still controversial. Therefore, we performed experiments at high pressure and temperature at the aim to better understand possible mechanisms that might be invoked to explain our finding. Abiotic hydrocarbons and graphite were observed after quenched experiments using piston cylinder and large volume press at pressures corresponding to upper mantle conditions along subduction zone. Gas chromatograph technique was employed to analyze the composition of coexisting fluids.

Based on the experimental and geological observation, we derive the following generalized reaction for graphite and hydrocarbons formation:

$Ankerite_{(highFe)}$+water=$ankerite_{(lowFe)}$ +magnetite+graphite+carbon dioxide+hydrocarbons+calcium hydroxide

This study would confirm the possibility of abiotic hydrocarbons forming in subduction zones as a result of dissolution-disproportionation reaction of Fe-bearing carbonate. On the other hand, dissolution-disproportionate reaction of Fe-bearing carbonate is an important mechanism to explain the existence of graphite or diamond in subduction zones and Earth's upper mantle.

Key words: Abiotic hydrocarbons; Dissolution; Disproportionate; Fe-bearing carbonate; Subduction; Upper mantle; Carbon

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