

"Experimental insight on the carbonaceous matter stability during subduction"

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Thermodynamic, experimental and field studies have suggested that organic compounds can be stable, and even dominate over inorganic carbon species, in subduction zones up to high pressure (HP; 0.5-6 GPa) and high temperature (HT; 600-1000°C). Slab-hosted organics can be formed either by carbonate destabilization during subduction or inherited from hydrothermal circulation at mid-ocean ridges. Of widespread occurrence in these settings are polycyclic aromatic hydrocarbons (PAHs) and/or genetically-related condensed carbonaceous matter, all spatially related to serpentine, and whose behavior during subduction is still unknown.

To assess the fate of these organic compounds during subduction, HP-HT experiments using either a piston-cylinder device or a multi-anvil press have been run at 500-1000°C and 3-7 GPa. Different anhydrous starting solids were tested, including either synthetic PAHs alone, with (1-hydroxypyrene, 1-pyrenebutyric acid) or without (pyrene) oxygen-bearing functional groups, or a mix of pyrene and powdered natural antigorite.

Our results show that the maturation of PAHs at HP-HT leads to the formation of graphitic carbon preserving a high structural disorder, possibly related to the persistence of O and H atoms in its network, far from pure graphite structure. We also observe the formation of aqueous fluids during oxygen-bearing PAHs experiments, suggesting water release from organics at HP-HT. Mix experiments involving pyrene and antigorite show various assemblages depending on experimental redox conditions, with oxidizing conditions stabilizing magnesite-enstatite-quartz over olivine-enstatite-graphitic carbon under reducing conditions. Our results highlight the poor reactivity of solid organic carbon towards serpentine-derived aqueous fluids under reduced conditions suggesting that the latter might facilitate the recycling of organic compounds to the deep mantle.