Metamorphic “unconventional” hydrocarbons in subduction zones

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The “Deep gas theory” considers that most hydrocarbon reservoirs on Earth are abiogenic and reflect a cosmic origin inheritance. The theory was first supported by the Russian community, and successively reprised by Tommy Gold, who suggested that most deep hydrocarbons form through abiotic processes in the mantle and migrate towards shallower reservoirs in the crust (the “Deep hot biosphere”). The theory remains highly controversial, and wether deep abiotic processes can produce hydrocarbons in significant amounts has not found natural proof yet. Serpentinization processes are known to favor conversion of CO_2 into abiotic CH_4 in shallow crustal settings such as mid-ocean ridges and ophiolites, where the intimate relationships with methanotrophic/methanogenic microbial communities challenges the identification of unarguable abiotic sources. Deeper in the Earth, such as in subduction zones, serpentinization can take place, but its potential role on the genesis of purely abiotic hydrocarbon fluxes is currently unknown. Here we present data from natural high-pressure conditions (>50 km depth) indicating that fluid-mediated metamorphic production and circulation of abiotic hydrocarbons can affect very large segments of a subducted oceanic plate. This discovery sets new perspectives on the significance of abiotic hydrocarbon genesis at upper mantle depths, and keeps open the debate on the existence of a Deep Hot Biosphere.