High-temperature high-pressure carbon isotope fractionation between COH-fluids and elemental carbon

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Carbon isotope fractionation in the system carbon-oxygen-hydrogen-fluid (COH-fluid) – graphite/diamond at deep-crustal and mantle conditions is currently best described by theoretical calculations. These predict a fractionation of -1‰ to 5‰ between CH_4 or CO_2 and graphite/diamond at temperatures between 800 to 1400°C [1-3]. Experimental work verifying these calculations is scarce. Our goal is the determination of equilibrium carbon isotope fractionation factors between elemental carbon (C^0) and COH-fluid at 800 to 1600°C, 2 to 60 kbar and varying oxygen fugacities at least between QFM and IW-3. The O:H ratio of the starting material defines the fluid speciation, i.e. CH_4, CO, and CO_2 fractions and the fO_2-value of the experiments [3] (Fig.1) and is therefore crucial for C-isotope fractionation [4]. We have hence designed a capsule-piercing-cell-assembly that allows contamination-free gas extraction from the experimental capsules and gas-storage in vials permitting multiple isotope and speciation analysis of the recovered fluid. The first experiments run in a fast-quench externally-heated pressure vessel at 2 kbar and 800°C produced sufficient volumes of gas and C^0 for multiple isotope analysis.

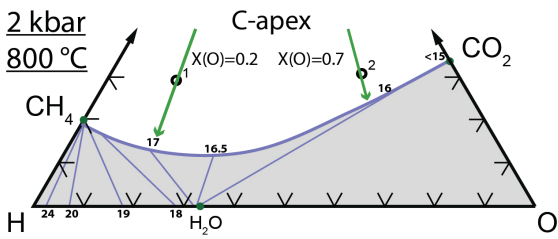

Figure 1: COH-ternary diagram. Blue C^0-saturation curve separates the C^0-COH-fluid field (white) from the COH-fluid field (gray). fO_2-isopleths are labeled in $-\log(fO_2)$. COH-compounds 1 and 2 decompose to a CH_4 and a CO_2-dominated fluid that would be in equilibrium with C^0.

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