Supplementary Materials

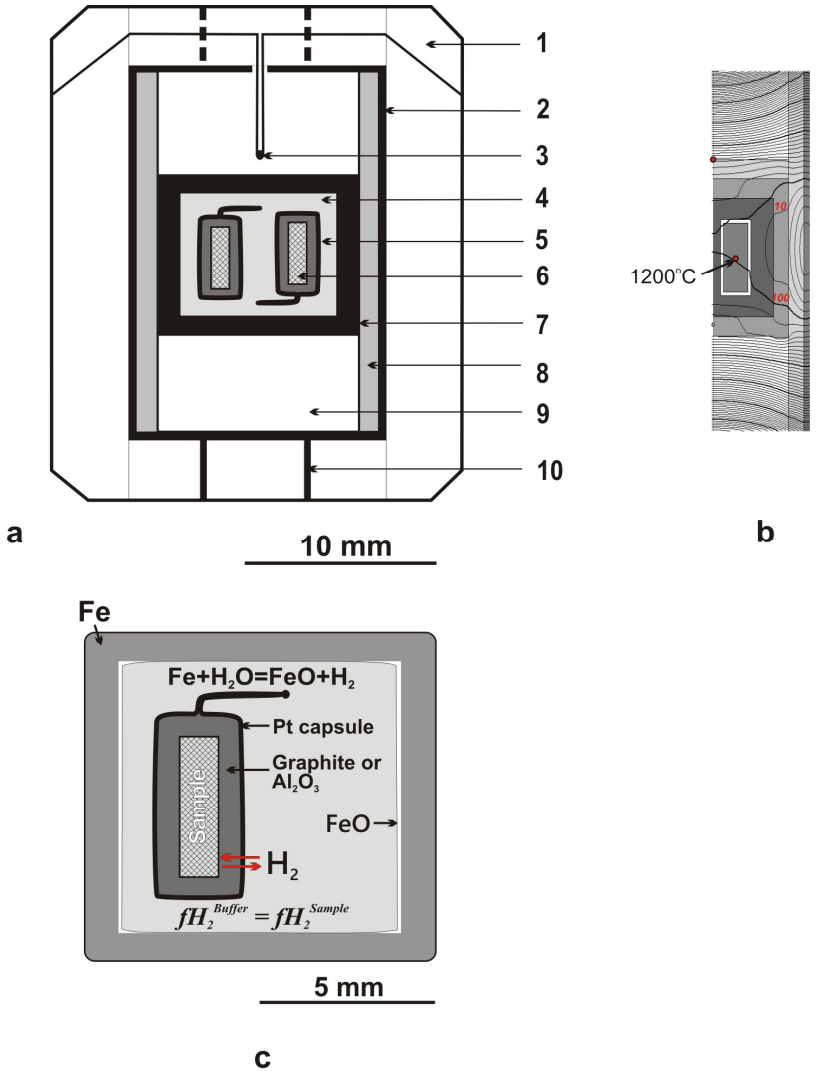

Figure S1. (**a**) The high-pressure cell; (**b**) temperature patterns in furnace assembly predicted using the software of Hernlund et al. [74] (simulations made for Pt capsule with graphite sample at 1200 °C, CsCl replaced by NaCl); (**c**) the double-capsule technique used to constrain the fH_2 conditions by the assemblage Fe + FeO + H2O buffer (water in the outer capsule was released by talc decomposition into coesite, orthopyroxene under the applied P–T conditions; the main volume between outer and inner capsules was filled by high-melting CsCl). 1—ZrO_2 container; 2—cylindrical graphite heater; 3—$PtRh_6/PtRh_{30}$ thermocouple; 4—talc and CsCl; 5—Pt capsule; 6—sample; 7—Mo or Fe capsule; 8—MgO; 9—ZrO_2; 10—Mo leads.

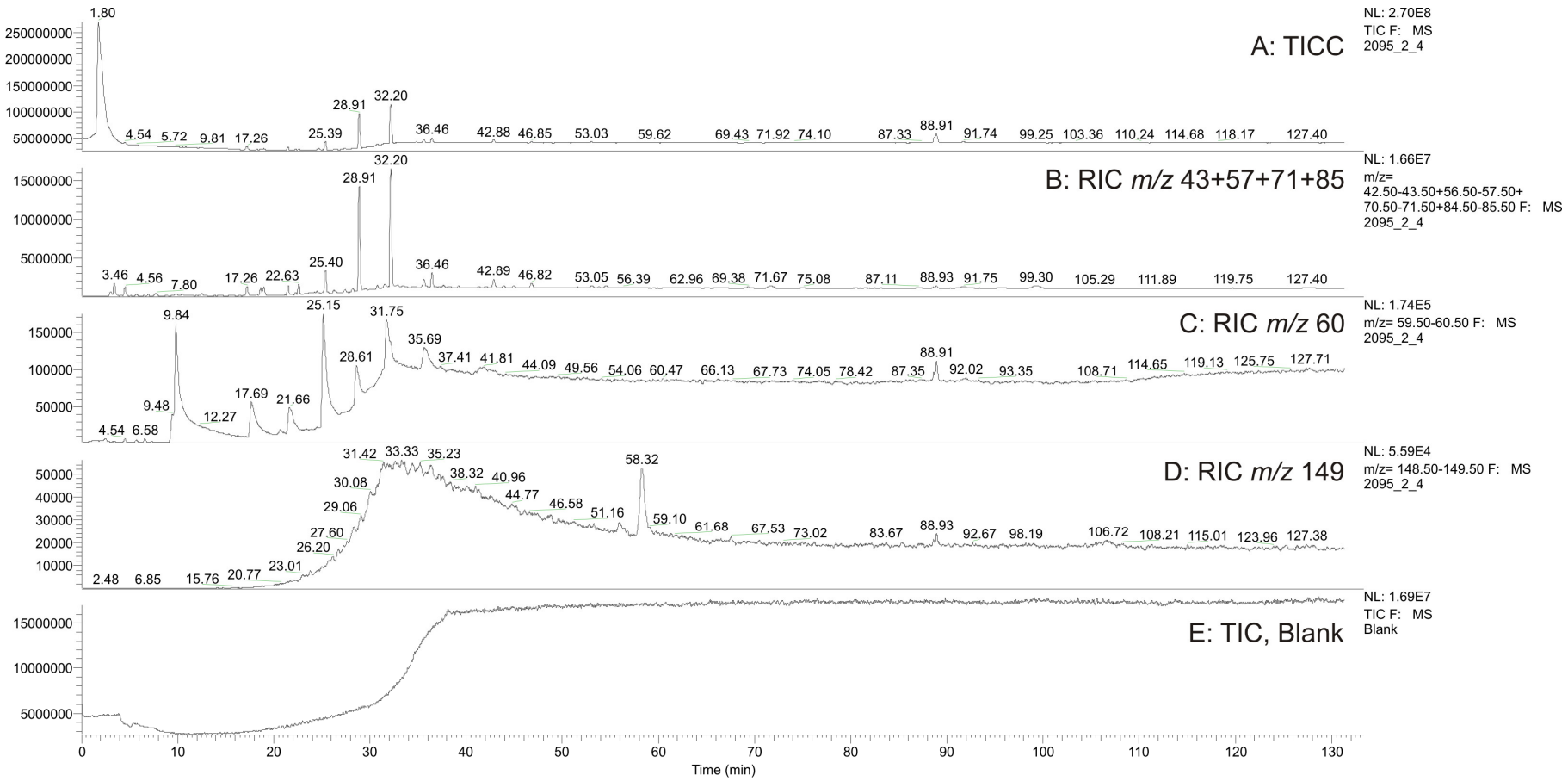

Figure S2. Results of GC-MS analysis of quenched fluid extracted by mechanical shock destruction from run 2095_2_4. (**a**) Total ion current chromatogram (TICC) and reconstructed ion chromatograms (RIC) for m/z 43+57+71+85 (**b**), m/z 60 (**c**), m/z 149 (**d**), and TIC of a pre-run system blank (**e**).

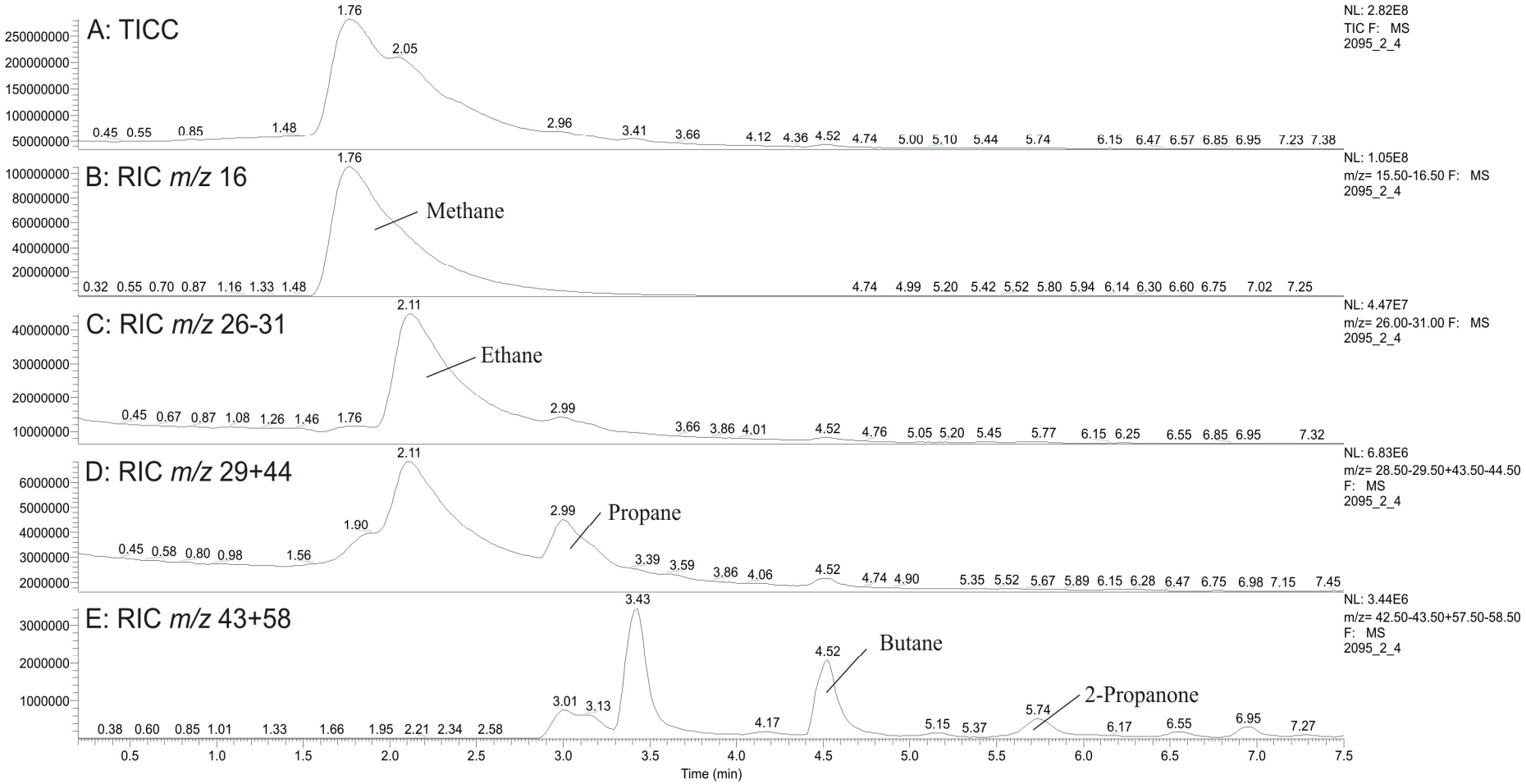

Figure S3. Results of GC-MS analysis of of quenched fluid extracted by mechanical shock destruction from run 2095_2_4. (**a**) Fragments of a total ion current chromatogram (TICC) and reconstructed ion chromatograms (RIC) for m/z 16 (**b**), m/z 26-31 (**c**), m/z 29+44 (**d**), and m/z 43+58 (**e**).

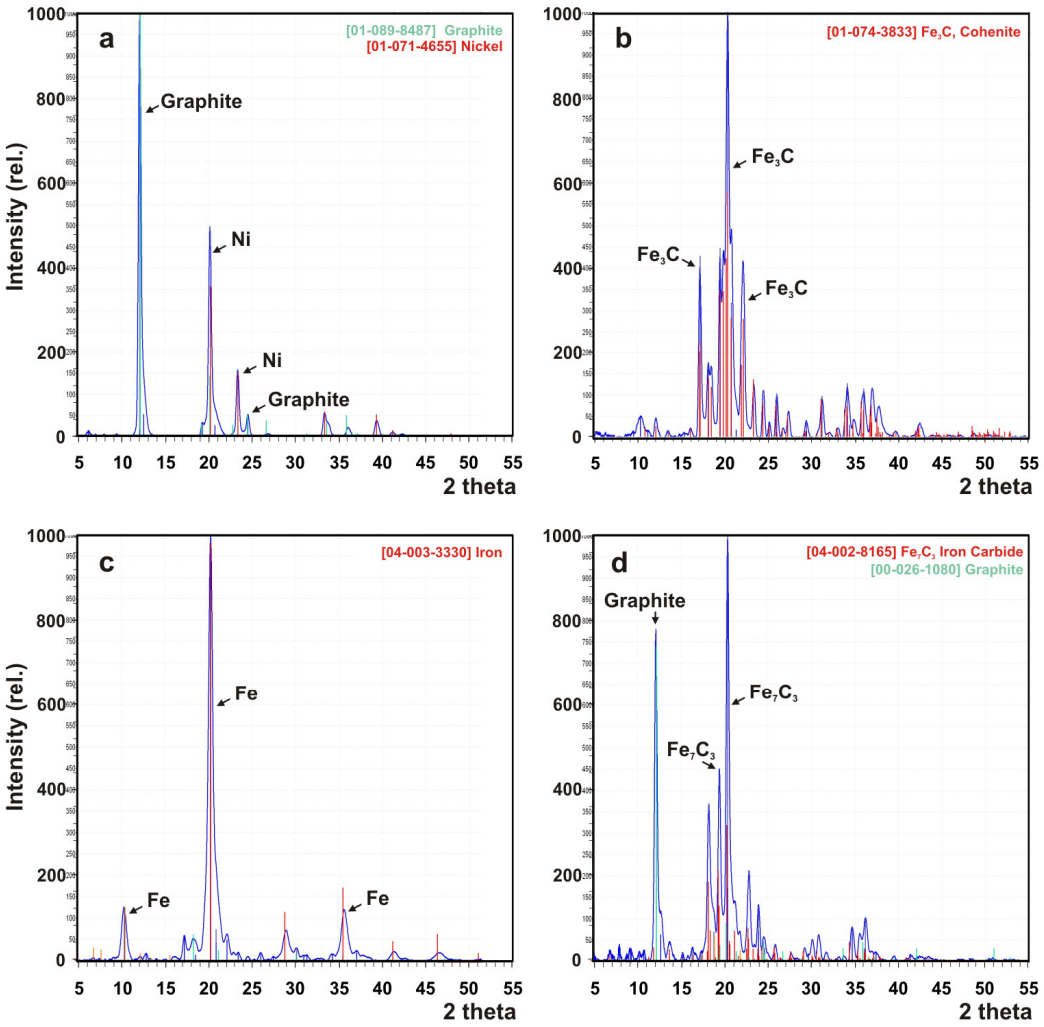

Figure S4. Phases identified by X-ray powder diffraction in the Gandolfi mode. The database of PDF-4 Minerals (The Powder Diffraction File PDF-4 +, 2006) was used for phase analysis. a: graphite and nickel, run 1001_4_3; b: iron carbide (Fe_3C), run 1001_4_4; c: iron, run 2095_2_2; d: iron carbide (Fe_7C_3) and carbon, run 2100_2_4.