Fe-Ni-P PHASE DIAGRAM AT 6 GPa.

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Introduction: The Fe-Ni-P is one of the basic phase diagrams for understanding core formation processes in planets and asteroids. Recent finding of high-pressure minerals in iron meteorites [1-3] and abundance of complex Fe-Ni-P-S quench textures with unusual bulk compositions indicate importance of the study of related systems at elevated pressures. Although most high-pressure minerals in meteorites originate under shocked conditions of impact during short time, static high-pressure experiments are more relevant for interpretation of these processes relative to shock wave experiments, where durations of shock is too short to model meteorite impacts.

Methods: We have experimentally determined the Fe-Ni-P phase diagram in the compositional range of 0-30 mol% P at 900-1100 °C and 6 GPa. Experiments have been conducted in ceramic ($3MgO{\cdot}4SiO_2$) capsules using a uniaxial multianvil apparatus 'Discoverer' installed at IGM SB RAS, Novosibirsk using conventional technique [4]. The temperature was maintained using a W-Re(3/25%) thermocouple. The uncertainties in pressure and temperature measurements did not exceed 0.5 GPa and 20 °C.

Results and discussion: At subsolidus conditions, the Metal (Me)-rich side of the ternary has three phases: Fe-Ni alloy, $(Fe,Ni)_{3-x}P$, where $x \leq 0.6$, and $(Fe,Ni)_2P$. The first melting occurs at 950 °C at the Ni-P join and controlled by the Ni_2P-Ni eutectic with composition of 18 mol% P. The melt field expands toward Fe-P side as temperature increases. The Fe_2P-Fe eutectic is found at 1100 °C and 16 mol% P (Fig. 1). In application, we compared experimental data with compositions of quenched Fe-Ni-P and Fe-Ni-P-S melts recorded in Elga IIE iron meteorite and concluded that they could be formed under high-pressures exceeding 6 GPa.

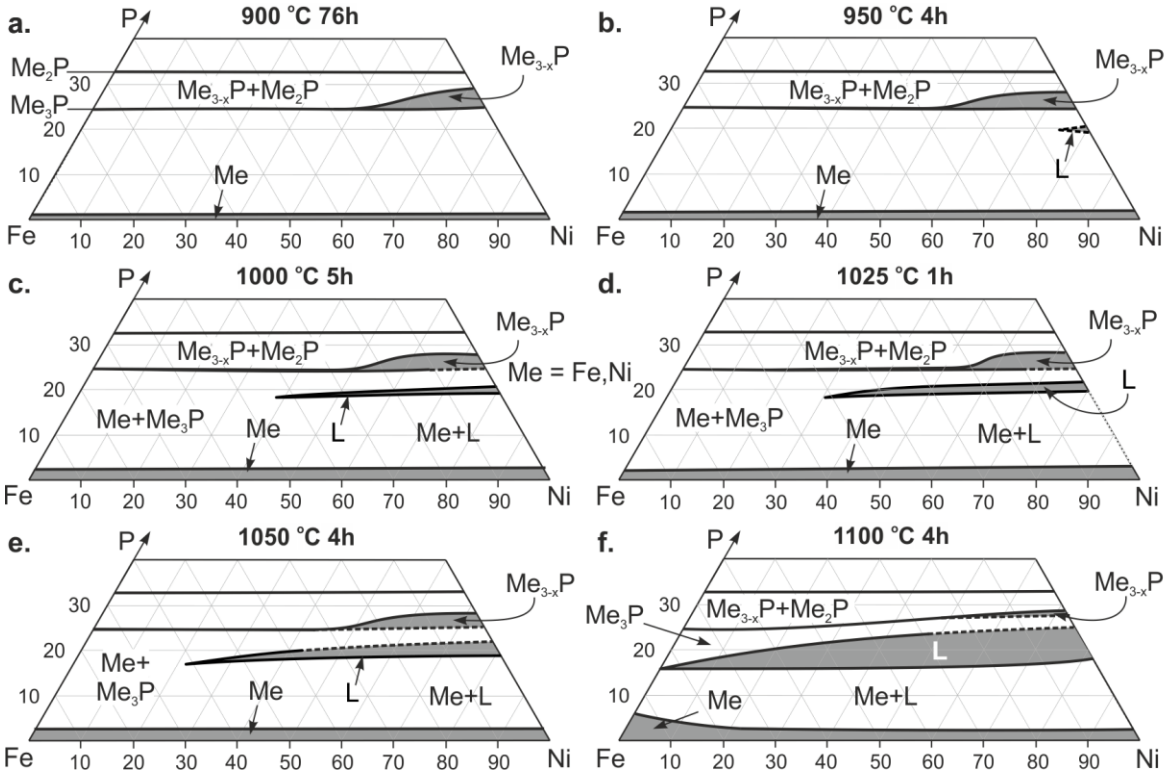

Figure 1. Isothermal sections of the Fe-Ni-P phase diagrams at 6 GPa. L – liquid.

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