SILICATE INCLUSIONS IN THE ELGA OCTAHEDRITE
II: SHOCK METAMORPHISM
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The structure and mineralogy of the Elga meteorite strongly indicate at the impact melting of the primary silicate inclusions with the subsequent crystallization of the mineral assemblages present (1).

The primary minerals of the silicate inclusions must have included a Fe-rich olivine (hortonolite), phosphate (whitlokite) which occur as relics, and the K-Na feldspar with no excess silica. The consequences of the shock were the melting of the silicate inclusions and the decomposition of phosphate and olivine, resulting in the formation of monoclinic pyroxene, schreibersite, quartz-feldspar glass and wüstite. This process can be shown as:

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\text{olivine} + \text{phosphate} + \text{Fe-Ni phases} \xrightarrow{\text{melting and decomposition}} \text{monoclinic pyroxene} + \text{schreibersite} + \text{silica} + \text{wüstite (magnetite)}. \\
\text{(glass)}
\]

This scheme appears to explain satisfactorily most of the mineralogical and structural characteristics of the Elga meteorite. The whitlokite decomposes to phosphorus and oxygen. The phosphorus react with the matrix metal to produce schreibersite and the Fe-Ni-P alloy which envelop the inclusion. The oxygen is consumed either in wüstite or magnetite formation depending on the temperature. The primary K-Na feldspar which is not involved in the reaction and remains molten, dissolves the releasing silica. The silica content of the feldspar glass from the Elga meteorite is much higher than that of the Kodaikanal meteorite (2). The X-ray analysis detected no high-pressure silica phases which would have formed had the silica been present in primary (pre-shock) inclusions as glass or a crystalline phase. The monoclinic pyroxene which crystallized out of the melt contains up to 50% trivalent iron (Novikov G.V., personal communication) which suggests a high oxygen activity in the melt. The equilibrium crystallization of the silicate inclusions would have made it impossible for the pyroxene to contain so much trivalent iron. The
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Injection structures (1) contain micron-size spheres of the Fe-Ni-P alloy and pure iron (figs. 1 and 2). These particles have formed as a result of the metallization of the iron in the silicate under the action of shock loads. The occurrence of the injection structures in the marginal regions of the silicate inclusions and the presence of a metal testify to the high oxygen activity gradients in the melt, as well as to the nonuniform distribution of shock loads. The Elga meteorite might have had several collisions of varying strength, and injection structures formed as the result of some later collision, not so strong as to induce the complete melting of the silicate inclusions.

The primary shock metamorphism was marked by the development of inclusions with liquid immiscibility structures. The possible reason for this might be the migration of the silicate melt between the inclusions connecting these structures. The immiscible melts have practically identical compositions, so that the boundary separating them must have formed when two melts of considerably differing temperatures had come into contact prior to the rapid cooling of the inclusion.

The Fe-Ni matrix of the Elga meteorite had clearly been deformed, and this shows up as the displaced Neumann's bands, banded structure, twisting kamacite and taenite crystals. The octahedrite structure occurs in fragments only. The presence of this structure indicates that the mechanical deformations did not make the meteorite temperature rise above 800K.

The silicate inclusions would melt, in spite of the metal matrix not being heated, if there was an additional source of heat, such as exothermal reactions. The inclusions could have accumulated strains, giving rise to local heat-evolution. Consequently, the silicate melt crystallized very rapidly even at low pressures, developed after the shock loads had been relieved.

The composition of the primary (pre-shock) silicate inclusions of the Elga meteorite appears to have developed at the earliest stages of the meteorite matter differentiation.
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REFERENCES:

Fig. 1. The silicate injection with the spheres containing reduced iron and Fe-Ni-P alloy. Reflected light, in oil. Scale bar 5 µm.

Fig. 2. A fragment of the metal injection with the silicate spheres. Reflected light, in oil. Scale bar 5 µm.