Chemical consequences of an impact of a comet: experimental simulation

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An impact of a comet into a planet is a rare but not unrealistic event. Such an impact differs from an impact of a meteorite by involvement of large quantities of volatiles. The appearance of some volatile-rich features among lunar findings was considered by some explorers as a remnant of an impact of a comet (e.g., [1]). On the other hand, a number of investigators attribute such volatile-rich lunar findings to fumarolic eruptions (e.g., [2,3]). There are some works considering mechanical issues of an impact of a comet into siliceous targets, but investigations of chemical con-sequences of such an impact are still lacking. There is no true experimental base which permits to identify remnants of an impact of a comet and distinguish between volatile-rich findings of cometary or another nature.

The aim of the present study was to simulate the chemistry of a spreading vapor cloud with a composition related to an impact of a comet into lunar basalts and to investigate chemical products of such an event.

Analysis of the condensed material shows that volatiles form separate phases and are concentrated mainly in the surface layer amounting there up to ~50 % by weight. Carbon was the most abundant among volatiles and was recondensed mainly as organic constituent, while carbonate bonding was also detected. Sulfur was also abundant (up to 7 wt.%) and was mainly bound in sulfides, but some S^0 and SO_2 was present in the surface layer. It was interesting to find phosphorus in phosphate and phosphide type of bonding. The same partitioning of P into phosphates and phosphides was observed in lunar “rusty” rocks [4].

The experiment shows that an impact of a comet can result in a sufficient interaction of volatiles with silicates. The production of a wide range of various types of volatile-rich components with non-equilibrium redox states must result in a complex post-impact chemistry affecting the planetary environment. The correlation of some lunar findings with experimental results supports their possible impact origin.

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Tungsten-tin deposits in southwest of Shazand, Iran

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Apart from Nezam-Abad tungsten deposit, Bamsar and Revesht are among the already discovered tungsten-tin occurrences in SW of Shazand, west Central Iran. Rare Earth Element (REE) and other trace elements in samples of scheelite ($CaWO_4$) from these deposits have been determined by Neutron Activation Analysis in order to constrain the composition and sources of the mineralizing fluids. The granitic and granodioritic intrusives have caused metamorphic haloes in the upper Triassic-Jurassic detrital-chemical and volcanic units. Six ore-bearing skarn horizons have been identified at Bamsar, while granodioritic intrusives host vein-type mineralization at Revesht and Nezam-Abad. Country rocks at Bamsar are mainly calcareous schists in which ore minerals occur in laminas and layers, whereas granodioritic intrusives host vein-type mineralization at Revesht and Nezam-Abad.

Revesht and Nezam-Abad scheelites have higher total REE and Na concentrations than Bamsar samples. Bamsar scheelites show flat chondrite-normalized REE (REE_N) patterns, whereas scheelites from Revesht and Nezam-Abad exhibit hump-shaped REE_N patterns with maximum REE_N concentrations displaced towards Dy. It is suggested that Bamsar scheelites have variable Eu anomalies and trivalent REE concentrations and thus appear to contain mostly Eu^{2+} and to have formed under reduced conditions (Ghaderi et al., 1999). Revesht and Nezam-Abad scheelites, on the other hand, exhibit no changes in the size of the Eu anomaly with REE concentration, implying a predominance of Eu^{3+} and crystallization under relatively oxidized conditions. Bamsar scheelites have $(Ce/Lu)_N > 1$ and are interpreted to have crystallized from LREE-enriched fluids, whereas Revesht and Nezam-Abad scheelites with $(Ce/Lu)_N < 1$ formed from LREE-depleted fluids. The elevated Na contents of Revesht and Nezam-Abad scheelites compared with Bamsar samples, suggest crystallization from hydrothermal fluids with higher Na activities.

It is suggested that Bamsar occurrence is sedimentary-diagenetic in origin, subsequent concentration happening through Late Kimmerian regional metamorphism and deformation. Considering spatial position and proximity of Bamsar ore-bearing horizons with granodioritic intrusions hosting vein-type mineralization at Revesht and Nezam-Abad, it is likely that the mineralized veins in those areas formed through assimilation of stratiform and stratabound ores by a granitoid magma.

Reference

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