Abstract

This work deals with microstructural features, chemistry and the search for traces of a meteoritic component in proximal tektite-like glasses from the Zhamanshin impact structure (Kazakhstan; further abbreviated as ZIS), and tektites from two strewn fields – moldavites (Czech Republic) and Australasian tektites (Laos; further abbreviated as AAT).

Detailed microstructural observations and subsequent chemical and mineralogical studies of various types of inclusions were also performed; these inclusions were mostly found in the studied types of glasses for the first time ever.

The aim of this PhD thesis was to (i) describe the microstructure of all studied glasses with a focus on yet unobserved microstructural phenomena, and (ii) try to determine the admixtures of meteoritic components in these glasses. In addition, the available target rocks, which could be a source of moldavites or AAT, were also studied. The microstructures of the studied glasses mutually differ. This is due to a diversity of parent materials and different glass formation conditions occurring during a particular impact event. A new type of "composite splash-form" has been identified among the ZIS glasses, whose chemical composition does not fit into the previously defined groups of irghizites or basic "splash-forms". For the first time ever, mineral bassanite (monoclinic $CaSO_4 \cdot 0.5\ H_2O$) was found in irghizites, which was identified on the basis of X-ray diffraction and Raman spectroscopy. Among notable contributions of this work is the discovery of two types of sulfide inclusions in MN AAT. Type 1 is composed of troilite (FeS), shenzhuangite ($NiFeS_2$; a rare mineral that has only been identified in highly shocked Suizhou L6 chondrite) and a "monosulfide solid solution" (mss). Type 2 inclusions are composed of chalcopyrite ($CuFeS_2$), as yet unspecified FeS phase and a monosulfide solid solution (mss). Type 1 inclusions appear to be of extraneous (meteoritic) origin whilst type 2 inclusions are presumably of terrestrial origin. This thesis also describes inclusions of unusual shapes, structures and compositions found in MN AAT from Laos.

One of the aims of the work was to compare a complex geochemical relationship of moldavite tektites and a set of Miocene sedimentary rocks from the area of the Ries crater representing possible CET source materials. The results support sediments as precursor materials of moldavites, but at the same time they require a process that would be able to

explain the enrichments in volatile elements in moldavites compared with the chemistry of the expected sediments.

Furthermore, the newly found Polish moldavite, which extends the largest distance with known occurrences of moldavites from ~ 420 km to ~ 475 km from the center of the Ries crater, was also characterized in greater chemical and structural details. The chemical composition of this find is indistinguishable from the general compositional trends of moldavites from other strewn sub-fields. However, there are inhomogeneous areas with increased contents of calcium and magnesium, which have so far been observed only in South Bohemian moldavites.

The presence or absence of the meteoritic component was tested by studying PGE, HSE, the isotopic system Re–Os, oxygen isotope compositions and chromium isotope systematics in glasses for selected specimens. Unambiguous identification of extraterrestrial material in tektites and tektite-like glasses is possible if sufficiently high contents of PGE and HSE are present, which allow a meaningful calculation of diagnostic parameters. The use of combined HSE abundances and Os isotope systematics can be affected by elemental fractionation or even significant loss of HSE from tektite glass in early stages of glass formation. The results obtained for moldavites and Australasian tektites indicate a possible minor addition of a meteoritic component from the projectile, although the nature of the projectile cannot be unequivocally characterized and/or quantified. Traces of the extraterrestrial component and the type of projectile were determined only for irghizites (proximal glasses from the ZIS) that were identified to be contaminated by a projectile of carbonaceous chondrite character, specifically CI type as devised by chromium isotope data.