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Lunar glass spherules

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Lunar soil samples contain glass spherules ranging in size from few micrometres to few millimetres. Textural and chemical characteristics of these glasses have been used to distinguish those formed by volcanic lava fountaining (picritic glasses) and impact melting (impact glasses), as well as detailed classification of spherules within these two major groups.

Further appraisal of textural and chemical variability of lunar glass spherules is made possible by recent advances in analytical techniques (such as high-resolution BSE, EBSD and EDS imaging). New high spatial resolution imaging of the glass beads from different landing sites shows a previously unknown textural complexity of both volcanic and impact melt beads. This imaging reveals a variety of finely developed textures even in the beads that may appear to consist of homogenous glass under optical microscope or when using lower resolution scanning electron microscopy. The range of textures observed in picritic glasses indicates variable cooling rates during their formation, while presence of partly and variably digested remnants of different mineral assemblages in impact glasses suggests different melting temperature attained by individual impact melt droplets. Further information about conditions of melting and cooling of individual beads can be obtained by investigating chemical compositions of glass and coexisting mineral phases.

Samples from Apollo 11, 14, 16, 17 and Chang'e 5 landing sites contain variable proportions of glasses representing three main chemical groups (highlands, mare, picritic), which is compatible with the range of rocks present at each of these landing sites. This compositional link to the landing site confirms previous conclusions of local origin of glasses with transportation distances probably not exceeding about 100 kilometres and less than about 10% of the population possibly originating at greater distances from the landing sites. Combination of textural and chemical characterisation of glasses helps to improve perception of the range of different crustal components contributing to impact glasses at each landing site and investigate volcanic vs. impact origin of mare glasses.