ABSTRACT

Study of spherules and spherule layers, in general, is increasingly becoming more important in planetary geosciences with the increase in reports of various types of ejecta layers. The thesis deals with the physico-chemical characterizations of spherules separated from the road deposited sediments and their comparison with microtektites, impact- and cosmic spherules.

The characterization of spherules from RDS and fly ash sample made with the help of different analytical instruments and techniques (optical microscopy, refractive index measurement, XRD, BSE-SEM, SEM-EDX, EPMA, Laser Raman- and Infrared spectroscopy) suggests that they are glassy, formed at high temperature, have undergone aerodynamic shape modification, derived from a coal-fired thermal power plant and are of anthropogenic origin.

The present study shows the close affinity the anthropogenic spherules shares with spherules of diverse origins in terms of their size, aerodynamic shape and composition. The anthropogenic spherules are observed having splash-form shapes, like spherical, ovoid, dumbbell and tear-drop. The different aerodynamic shapes of anthropogenic spherules resemble other terrestrial and extra-terrestrial spherule types. Recently reported silicate spherules of Permian age in Canadian High Arctic formed by the burning of Siberian coal beds due to volcanism, are very similar to the present day coal-fired fly ash spherules. This makes it mandatory to create a database on anthropogenic spherules, especially those formed due to coal combustion.

Their size of the anthropogenic spherules varies between 2 and 3000 µm and other genetic spherule types measure within this size range. The anthropogenic spherules, despite their physical similarities, can be delineated from microtektites and impact spherules with the help of a three component [SiO$_2$–(CaO+MgO+FeO$_T$)–Al$_2$O$_3$] variation diagram suggested here. The REE data of anthropogenic spherules generated for the first time are compared with other genetic spherule types. The anthropogenic spherules, microtektites and impact spherules show similar REE pattern marked by LREE enrichment, HREE depletion and negative Europium anomaly although their respective $\sum$REE are variable. However, they exhibit REE pattern similar to Upper Continental Crust composition. In contrast, the spherules of cosmic origin are highly depleted in $\sum$REE and exhibit a characteristic un-fractionated REE pattern.