

## Diamonds: A Special Issue in honour of Vladimir S. Sobolev Preface



Vladimir S. Sobolev in 1976

*This issue of the European Journal of Mineralogy is dedicated to the memory of Vladimir S. Sobolev, on the occasion of the 100th anniversary of his birth, and his critical role in the discovery of the Siberian diamond deposits. Vladimir Sobolev was an eminent petrologist and mineralogist and is a Past President of the International Mineralogical Association.*

*Sobolev was born 1908 in Lugansk, Ukraine. He graduated from the Leningrad Mining Institute in 1930, and during the 1930's taught at the Mining Institute in Leningrad, where he carried out a detailed petrological study of the flood basalts (traps) and associated volcanics of the Siberian Platform (Sobolev, 1936). In this book he pointed out for the first time that the geological map of the Siberian Platform is very similar to that of South Africa.*

*During his petrologic work on the Siberian Platform, Vladimir Sobolev identified augitite, limburgite and olivine melilitite, which are very similar to the rocks associated with the kimberlites of South Africa. These results, along with the overall geological and tectonic resemblance of the Siberian Platform to South Africa, led Sobolev to suggest — first in a paper to the International Geological Congress in Moscow in 1937, and then later on in an unpublished report (Sobolev, 1941) — that the northern part of the Siberian Platform might be an area with kimberlite intrusions. In the above report he wrote: “Every expedition working in the northern part of the Siberian Platform should devote serious attention to exploration for kimberlites and diamonds. It is especially important to draw attention to exploration for diamonds in the workable placers of precious metals in the Norilsk area and at the Vilyui River”. Part of this report was later published (Sobolev, 1951). Only 14 years later, the famous Mir pipe was discovered at the Vilyui River, followed by the discovery of several hundred kimberlite pipes in the new Yakutian diamondiferous province.*

*During 1945–1958, Sobolev joined Lvov University and continued to study volcanic rocks, including those of the Ukraine. His theoretical work on silicate mineralogy led to the publication of a book (Sobolev, 1949). His scientific approach to igneous and metamorphic rocks, as well as their minerals, was based on physicochemical principles (Zavaritskii & Sobolev, 1964).*

*In 1958 Sobolev was invited to Novosibirsk by Profs. M.A. Lavrent'ev and A.A. Trofimuk to join a newly established Siberian Branch of the Academy of Sciences of the USSR. He enthusiastically became one of the founders of the Institute of Geology and Geophysics and its Deputy Director until 1980. Here he continued his work on theoretical mineralogy and a wide spectrum of metamorphic rocks, with special attention to high-pressure crustal and mantle rocks from different Siberian areas. In particular, he studied the Siberian kimberlites themselves, including their diamonds, introducing the techniques of experimental petrology and the study of fluid inclusions in magmatic and metamorphic minerals (Sobolev, 1959, 1960, 1972a, b, 1975, 1983). He initiated a special project for the mapping of metamorphic facies. A very first map was published for a specific large region such as the USSR (Sobolev, 1966), followed by additional international activities applying a similar approach to the mapping of metamorphic rocks of different continents within the framework of a Commission led by Prof. Henk Zwart (e.g., Sobolev, 1983).*

*Vladimir S. Sobolev passed away on Sept. 1, 1982, in Moscow. For his scientific achievements he received many honours, both in his own country and abroad, and in 1958 was elected a full member of the Academy of Sciences of the USSR. Sobolev received the highest awards of his country, including both the Lenin and State Prizes, the first in recognition of the series of maps and books on metamorphic facies compiled together with his colleagues and former students (Sobolev, 1966, 1972a, b, 1975), and the latter in recognition of his book on the mineralogy of silicates (Sobolev, 1949). He was also a Fellow of the mineralogical societies of the USSR, Austria, Great Britain and Ireland, France and Czechoslovakia. In the period 1974–1978 he was elected President of the International Mineralogical Association, and in 1978 he was the host for the 11th General Meeting of the International Mineralogical Association in Novosibirsk.*

*On February 18th, 2008, the Presidium of the Russian Academy of Sciences, its ruling body, decided to bestow the name of Vladimir S. Sobolev on the Institute of Geology and Mineralogy of the Siberian Branch of the Russian Academy of Sciences (RAS), which represents the major part of the erstwhile Institute of Geology and Geophysics and is now the*

*host for the 11th General Meeting of the International Mineralogical Association in Novosibirsk.*

*On February 18th, 2008, the Presidium of the Russian Academy of Sciences, its ruling body, decided to bestow the name of Vladimir S. Sobolev on the Institute of Geology and Mineralogy of the Siberian Branch of the Russian Academy of Sciences (RAS), which represents the major part of the erstwhile Institute of Geology and Geophysics and is now the*

largest geological institute of RAS. From this time onward, the Institute will be the V.S. Sobolev Institute of Geology and Mineralogy of the Siberian Branch of the Russian Academy of Sciences.

The collected papers by scientists from Russia, Germany, Japan, UK, USA and Canada in this special volume cover a wide range of different aspects in diamond studies. They have evolved from a special session entitled “Kimberlites, diamonds, and mineral inclusions from the mantle” held during the 19th General Meeting of the International Mineralogical Association in Kobe, Japan, in 2006. The topics studied not only embrace investigations of diamond itself, but also studies on minerals included in diamonds and diamondiferous xenoliths, which have immensely increased our knowledge of the Earth’s mantle where diamonds commonly form.

Since Vladimir Sobolev’s pioneering research, the extent of scientific information available from studies on diamonds and their inclusions, mantle xenoliths and crustal metamorphic rocks have expanded immensely. This has arisen from the development and application of many new techniques of diffraction and spectroscopy, together with the possibilities provided by ultra-high pressure and temperature experiments. The use of these techniques and the new types of information they provide are particularly well exemplified by the papers in this volume.

The volume begins with papers presenting various aspects of diamond inclusion studies. High-precision geochemical analyses of minor elements in olivine inclusions from Siberian and Canadian diamonds are presented by Sobolev *et al.*, whilst new insights on diamond formation come from the investigation by Logvinova *et al.* of primary nanometre-sized, diamond-shaped inclusions composed of closely associated primary syngenetic minerals and high-density fluids (HDF). With the application of the SEM-EBSD technique, Cayzer *et al.* show how phase transformations in lower mantle mineral inclusions cause plastic deformation in their host diamonds.

Papers employing high pressure-temperature experimental techniques then follow. Spivak *et al.* and Shushkanova *et al.* examine distinctive aspects of diamond growth in sulphide-carbon melts (with and without carbonate and silicate phases). Arima & Kozai explore the crucial topic of how diamonds may undergo dissolution in the kimberlite melts which commonly transport diamonds to the Earth’s surface. Reutsky *et al.* use the ion microprobe to monitor the detailed changes in carbon and nitrogen isotope compositions of diamonds grown under controlled conditions by the metal catalyst technique.

The last three papers in the volume tackle broader issues of diamond formation and occurrence. Spetsius *et al.* provide oxygen isotope data on garnets from diamondiferous xenoliths and give further evidence that crustal rocks subducted into the mantle are an important source for diamonds. The enigma of the origin of carbonado diamonds is tackled with Raman and Infrared spectroscopy by Kagi & Fukura. Finally, the relatively new discoveries of metamorphic diamonds formed *in situ* in especially thick crust are evaluated by Pechnikov & Kaminsky.

Our sincere thanks are due to Walter Maresch, Roli Oberhänsli, and Christian Chopin for their patience, invaluable constructive assistance and fruitful cooperation in the preparation of this Special Issue.

Makoto Arima, Ben Harte, Nikolay V. Sobolev  
Guest Editors

## References

- Sobolev, V.S. (1936): Petrology of traps of the Siberian Platform. *Proc. of Arctic Institute*, Leningrad, **43**, 214 p. (in Russian).
- Sobolev, V.S. (1941): A comparative study of geological structures of foreign diamond deposits and different regions of the USSR. Unpublished report N 7537, Geological Institute, St. Petersburg.
- Sobolev, V.S. (1949): Introduction to the mineralogy of silicates. Lvov State University, Lvov, 328 p. (in Russian).
- Sobolev, V.S. (1951): Geology of diamond deposits of Africa, Australia, Borneo island and North America. *Gosgeoltechizdat*, Moscow, 127 p. (in Russian).
- Sobolev, V.S., ed. (1959): Diamond deposits of Yakutia. *Gosgeoltechizdat*, Moscow, 527 p. (in Russian).
- Sobolev, V.S. (1960): Conditions of formation of diamond deposits. *Geologiya i Geofizika*, **1**, 7-22 (in Russian).
- Sobolev, V.S., ed. (1966): Facies of regional metamorphism of the USSR. Explanatory notes to the Map of metamorphic facies of the USSR, 1:7500000. Nauka, Novosibirsk.
- Sobolev, V.S., ed. (1972a): The facies of metamorphism. *Austral. Nat. Univ., Dept. of Geology publ. No. 214*, Canberra, 416 p. Translated from Russian edition (1970) by D.A. Brown.
- Sobolev, V.S., ed. (1972b): The facies of metamorphism at moderate pressures. *Austral. Nat. Univ., Dept. of Geology publ. No. 236*, Canberra, 297 p. Translated from Russian edition (1972) by D.A. Brown.
- Sobolev, V.S., ed. (1975): The facies of regional metamorphism at high pressures. *Austral. Nat. Univ., Dept. of Geology publ. No. 266*, Canberra, 361 p. Translated from Russian edition (1972) by D.A. Brown.
- Sobolev, V.S., ed. (1983): Metamorphic complexes of Asia. Nauka, Moscow, 350 p.
- Zavaritskii, A.N. & Sobolev, V.S. (1964): The physicochemical principles of igneous petrology. Jerusalem, Israel Program for Sci. Translations, 414 p.