PARAGENESIS AND PECULIARITIES OF SULPHIDES IN DIAMONDS AND MANTLE XENOLITHS FROM KIMBERLITES

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Study of syngenetic inclusions in diamonds has revealed that in Yakutian stones sulphides are strongly predominant over oxide and silicate minerals. Microprobe analysis of sulphides in diamonds from several kimberlite pipes in Yakutia indicates that they mostly have a multiphase composition. The following assemblages are distinguished: pyrrhotite + pentlandite ± chalcopyrite, pyrrhotite + m_{ss}, m_{ss} + pentlandite (or violarite - like phase) ± jerfischerite, pyrrhotite + pyrite. Pyrrhotite is among the major phases that comprise the sulphide inclusions in diamonds.

In addition to diamonds, sulphide inclusions have also been found in all xeno- and phenocrysts of kimberlite rock minerals: olivine, ilmenite, garnet, and zircon. The sulphide nodules are usually multiphase with pyrrhotite predominating; Pentlandite and chalcopyrite are also present; some jerfischerite occurs in the ilmenite.

Studies of the sulphide parageneses in mantle xenoliths from Yakutian kimberlites have shown that they characteristically have a wide range of phase and chemical compositions. As indicated by mineragraphic investigation of various mantle xenoliths in Yakutian kimberlite pipes, the sulphide are most abundant in basic xenoliths represented by various types of eclogites, garnet websterites, and garnet pyroxenites.Quantitatively, the sulphides generally constitute tenths of a volume percent of the rock and very rarely up to 3-5 volume percent. In ultrabasic xenoliths, the sulphide content is much lower and does not exceed 0,5 volume percent. Sulphide inclusions occur in the grains of the rock -forming minerals and, more often, in the intersticies between them; their size ranges from a few microns to one or, rarely, more mm.

We made microprobe analysis of IOO xenoliths of eclogites and rocks of similar composition, approximately one third of the xenoliths being diamondiferous. Most of the sulphide nodules are of multiphase character. The most common assemblage is pyrrhotite + pentlandite + chalcopyrite ± pyrite, with pyrrhotite and pentlandite predominating. Less common are the multi- and monomineral sulphides: pyrite, chalcopyrite, jerfischerite, and m_{ss} containing 35-45 mass percent Ni: Some samples contained polydymite and native iron.

Peculiar features of the sulphide inclusions in diamonds and xenolith minerals, such as a partly rounded shape, looseness, and the character of mineral phase interrelations indicate that they were originally droplets of a sulphide melt that crystallized later. Probably in the case of rapid cooling of an entrapped droplet provided the kimberlite material was erupted, m_{ss} could persist as a quench phase. In accord with experimental data, in the case of slow cooling the assemblages pyrrhotite + pentlandite + chalcopyrite, etc. were formed. Thus the resultant low-temperature sulphide assemblage has originally been a high-temperature m_{ss}. Therefore the abundance of the sulphides is at no variance with the high P-T parameters for the origin of diamonds and xenoliths. The intersticial sulphides are thought to have had similar origin and evolution except that they probably evolved under conditions of an open system and were affected to a larger degree by deep-seated metasomatism, a process common in the upper mantle rocks. Particularly, that jerfischerite has resulted from a stage of mantle metasomatism is indicated by a secondary character of its relations with other sulphides, heterogeneity of its composition within the grains, its restriction to intensily metasomatized xenoliths, and other factors.

Comparison of the sulphides in diamonds with those in various mantle assemblages made on the basis of our and published data shows (see Table) that the diamond sulphides are most similar in abundance and presence of individual phases to the sulphides in eclogite xenoliths. The latter show no apparent specialization in their parageneses or composition and the sulphides from diamondiferous specimens exhibit no special features either.

Study of the sulphides in diamonds and mantle xenoliths shows that a sulphide system has played an important role, together with a silicate medium represented by two geochemical types (ultrabasic and eclogitic), in the origin of natural diamonds. The difinition of the place and role of sulphide melt in diamond nucleation and crystallization is the target of further study.

Minor elements		Inclusions in diamonds	From ultrabasic xenoliths	From eclogites	Inclusions in olivine	Inclusions in ilmenite	Inclusions in garnet	Inclusions in zircon
Pyrrho-tite	Ni	0-7:0	0.09-0.6	0.07-I0:47	3-I2	I.8	3:99-8:35	4-I8:38
	Co	0-0.65	0-0:I	0- 2:50	0.II-0:22	-	0.06-0.38	0-0:73
	Cu	0-2.32	0-0.08	0- 3.42	0- I.46	0.97	0-0.I5	0-2.49
Pent-landite	Co	0.II-I.05	0-6:07	0-I:44	0:43-0:89	-	0:5I-0:79	0-2.07
	Cu	0-I.5I	0.05-I.76	0.05-5.I5	0.08-0.I5	3.29	0.II-0.36	0.07-I.I9
Chal-copy-rite	Ni	0:5I-I.07	0.74-8.2I	0-0.62	0:06-0:67	0.24	0.28-0:4I	-
	Co	0.-0.07	0.I4	0.- 0.09	0.03-0.34	-	0-0.I0	-
Pyrite	Ni	0:2-5.7	-	0:I5-0:52	-	0-0.39	-	-
	Co	0:04-2.08	-	0.05-3.76	-	-	-	-
	Cu	0.6-3.24	-	0-0.76	-	0-0.05	-	-
Jerfi-sche-rite	Ni	I3.70-I7.30	I0:09-I5.30	4:6I-9.94	-	I0.95-I9.33	I0.39-I3.0	-
	Co	0-0.22	0:I0-0:67	0:II-0.54	-	-	0:I8-0:35	-
	Cl	I:89-5:55	0.44-2:I5	4:70-I9.87	-	0:08-7:80	3.55-6:96	-
	K	7.40-9.29	8.89-II.48	9.20-9.77	-	7.66-8.30	9.2I-9.97	-