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HIGH-REDUCED MANTLE MINERAL ASSOCIATION IN VOLCANICLASTIC ROCKS OF EXPLOSIVE STRUCTURES. ESSENTIAL FEATURES AND CLASSIFICATION

An exotic association of mineral particles from volcaniclastic rocks of kimberlite and lamproite structures located at Ukrainian Shield, Arkhangelsk and Yakutian diamond provinces has been discovered and studied [1; 2; 3; 4]. This association includes Ti-Mn-Fe-silicate (TMIS), Ca-Al-silicate (CAS) spherules and magnetite-wustite (MW-I) one; spherule-like particles are composed of native metals and intermetallic alloys; suite of oxygen-free minerals including diamond, moissanite (SiC), qusongite (WC); mantle corundum with inclusions of metallic phases and osbornite (TiN). Primary compositions of mineral particles were obtained by energy dispersive spectrometer attached with scanning electron microscope. The results of the research were reported in our previous articles [1; 2; 3; 4; 5]. There we interpret the formation of this strongly reduced mineral association in terms of the processes that take place within transitional mantle-core zone (layer D''). This assumption is consistent with concepts provided by Kaminsky [6, p. 281]. So, we termed suite of studied mantle-derived particles as high-reduced mantle mineral association (HRMMA). In order to create classification of mantle-derived particles an attempt has been made to draw together published information [7-16] and our own observations (table 1). Current version of the classification is shown in fig. 1. There are some difficulties with the applying of the term spherule in classification because in fact this term exclusively reflects the morphological features. With regard to the underlying processes spherules are particles that formed from melt which was then sprayed and cooled in a fluid environment. From this view point metallic spherule-like and irregular particles can be ascribed to spherule class as well.

Table 1

Suite of HRMMA in various explosive structures

Rock formations	Structures	High-reduced mantle mineral association												
		Silicate-metallic spherules		Metallic and intermetallic spherules and irregular particles						Oxigen-free minerals				Mantle corundum
		TMIS	CAS	MW-I	Fe, Fe-Ni-Cr	Cu, Cu-Zn	Pb, Pb-Sn	Pb-Sn-Sb-As	Au, Au-Ag	Diamond	Moissanite	Qusongite	Cohenite	
Kimberlites	Pivdenna pipe						pd		pd	pd	pd		pd	
	Shchors dyke													
	Karpinska-1 pipe									pd				
	Udachnaya, Mir and Aikhal pipes [8]	pd	pd	pd	pd	pd	pd		pd	pd	pd			
	Cathoca pipe	pd	pd	pd			pd			pd				
Lamproites	Mriya pipe								pd	pd				
	Zelenyi Gay pipe									pd				
	Nord Gruzka dish-shaped structure									pd				
Tufisites	Intrusive piroclastic bodies, Vysherites [14]	pd	pd	pd						pd	pd			pd
	Tufisites, Putryntsi Site													
Disputable structures	Bovtyshka ring structure	pd	pd	pd							pd			
	Belylivka ring structure [13]	pd		pd						pd				

*Notes to table 1: Pivdenna and Mriya pipes – Azov Block of Ukrainian Shield; Shchors dyke, Nord Gruzka structure, Zelenyi Gay pipe and Bovtyshka ring structure – Ingul Block of Ukrainian Shield; Karpinska-1 pipe – Arkhangelsk diamond province; Udachnaya, Mir and Aikhal pipes – Yakutian diamond province[8]; Vysherite intrusive bodies – Western Ural [14]; Putryntsi Site – Southwestern Slope of Ukrainian Shield; Belylivka ring structure – Podilskyi Block of Ukrainian Shield [13].

** Empty grey cell – our own discoveries; grey cell with "**pd**" – published data.

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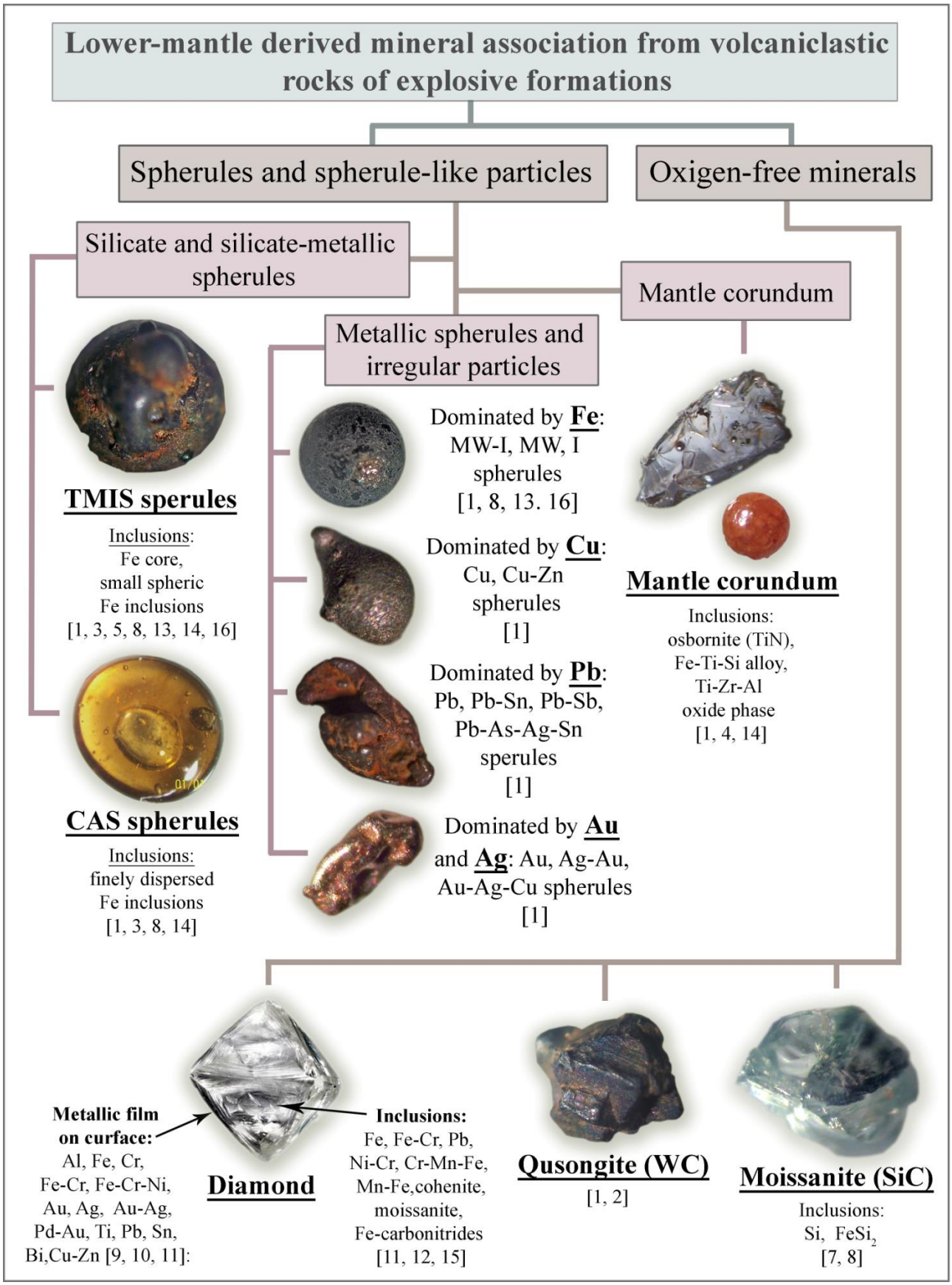

Fig. 1. Classification scheme of high-reduced mantle mineral association

Source: created by authors

The ability to form a spherical shape depends on the physical properties of a particular substance. Since the silicate substance as well as native iron, gold are commonly formed classic spherule shapes whereas Zn, Pb, Cu, Sn, As, Sb particles only in some cases are spherical-shaped but in the majority of cases they show melted irregular shapes. Key observation is that components of HRMMA occur only as individual particles. They show no interrelations between them. Thus it is more likely that spherule particles were forming from individual sources of corresponding melts. Although quite convincing correlation is observed between the compositions of films on diamonds and the compositions of metal spherules. So, it is very likely that oxygen-free minerals were crystallized into melt in the first place.

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