Part III
India – Eurasian Collision-Related Cenozoic Magmatic Activities

Study of Cenozoic magmatic activities and mineralization processes related to India – Eurasian collision tectonics was actively carried out during the 90s of the previous century. Review of recently published studies shows mineralization-types such as Cu, Cu-Au, Cu-Mo-Au porphyry, TR-Ba-F, Pb-Zn-Ag and others that were formed temporally coincident with India- Eurasian collision-induced Cenozoic mafic and alkaline magmatism. The magma associations in collision belts, large-scale shear zones (for example, the Ailao Shan – Red River) as well as in the collision-influenced structures show heterogeneous in compositions and complex in occurrences. Contemporaneous alkaline -mafic and -granitoidic magmatism is reported to found in similar collision-induced geological structures in Pamir, Tibet and southeast margins of the Yangtze craton (e.g. Scharer et al. 1994; Vladimirov et al. 2000; Dimitriev et al. 1976; Hacker et al. 2005). Two granitoidic activity stages are being divided along the collision-induced belt, early stage at 60 – 34 Ma and the other at 21 – 19 Ma; the alkaline mafic magmas occurred mainly in the interval of 45 – 25 Ma, while the alkaline granitoidic magmas appeared between 18 and 11 Ma.

Associated with the alkaline mafic magmatic activities was mineralization of Ag-Sb and Cu-Ag aged about 45 Ma in Pamir (Pavlova and Borisenko 2009) and at 50 – 45 Ma in Tibet (Lanping ore belt) (e.g. Hou et al. 2003); whereas associated with a latite complex in the Yulong belt east of Tibet were Cu- and Cu-Mo-Au porphyry mines aged about 40 – 35 Ma (c). According to Dimitriev (1976) the formation of Cu-Au and Gandeze Au-porphyry ore belt west of Tibet was related to 18 – 11 Ma granitoidic and latite magmatism, while in Pamir (and Tibet) F-TR mineralization in carbonatite was associated with alkaline magmatic associations aged 16 – 11 Ma.

In general, the structures in the current Himalayan collision zone are recorded as mineralized zones having a number of industrial-value ore deposits such as Cu, Mo, Au, Ag, Sb and other precious metals. One of the most important India – Eurasian collision-induced structures is the Ailao Shan – Red River shear zone (Tapponnier et al. 1982; Leloup et al. 1995). Extrusion magnitude of the Indochina block relative to the Yangtze craton along this shear zone in the Cenozoic (35–22 Ma) is about

700 km (Chung et al. 1997). The Ailao Shan – Red River Shear zone starts from east Tibet running along western margin of the Yangtze to the Viet Nam East Sea. Magmatism and ore mineralization in the shear zone is basically analogous to those in structures in the above described Pamir and Tibet. A segment of the Ailao Shan fault zone within China shows a number of Cenozoic magmatic activities including granitoid, alkaline mafic and felsic and their accompanying ore mineralization of Cu-Au- porphyry, Au, Au-Sb and Ag (Hu et al. 1995; Zhang et al. 1998 Zhang et al. 2005; Wang et al. 2001; Hou et al. 2005; Li et al. 2008). Industrial-value ore zone containing Cu- and Cu-Au – porphyry type aged 40 – 36 Ma and 16 – 11 Ma in this segment along with the Au-mineralized Ailao Shan belt (Au-As and Au-Sb mineralization of 30 Ma) as well as other Ag and precious ore deposits are identified.

In Viet Nam, India – Eurasian collision-related magmatic activities are closely associated with the formation of Red River fault zone and nearby structures (such as Phan Si Pan, Song Da) (Hoa 1995, 1997, 1999, 2000, 2003, 2005, 2007; Anh et al. 2001, 2002; Polyakov et al. 1997; Izokh et al. 2004). The Paleogene – Neogene ultrapotassic mafic magmatic activities occurred between Song Da and Phan Si Pan structures in northwestern Viet Nam show characteristics analogous with those magmatic activities in Pamir (e.g. Bargan, Kyzylrabat, Dunkeldyk complexes, etc.) (after Pavlova and Borisenko 2009) and Tibet (Chung et al. 1997; Li 1997). This similarity allows for identifying a collision-related Cenozoic ultrapotassic magmatic belt whereby Viet Nam (especially the northwestern) becomes an important joint of this specific magmatic series. According to the latest studies, Cenozoic magmatic activities in the Red River high-temperature –pressure metamorphic belt as well as in the nearby Phan Si Pan and Song Da structures are divided into three stages based on strong extrusion (motion) rate of the Red River fault zone during 35 – 22 Ma interval. The three stages include pre-extrusion (42-35 Ma), syn-extrusion (35-25 Ma) and post-extrusion (22-19 Ma). The pre-extrusion magmatic formations contain pluton-volcanic bimodal alkaline mafic and ultrapotassic associations including (lamproite, absarokite, minette, etc.) and alkaline felsic, such as trachyte, granosyenite, syenite, etc (Hoa 1995; Hoa 2005, 2007; Chi 2003, Polyakov et al. 1997; Anh et al. 2001). The formation age of this magmatic association may lie between 42 – 35 Ma. The syn-extrusion magmatic associations (35 – 25 Ma) in the Red River zone consist mainly of mafic and ultramafic intrusion bodies of lherzolite, websterite and amphibole gabbro; while magmatic associations in the Phan Si Pan uplift contain 35 Ma Ye Yen Sun granite (Shaerer et al. 1994; Dung 2012). The post-extrusion magmatism is observed in the Red River fault zone as undeformed mafic (dolerite) veins and dykes and small bodies of leuco-granite or granitic aplite, pegmatite having formation ages varying between 24 and 19 Ma (Hoa 2007).

Following the above descriptions it is clear that India – Eurasian collision-related magma – mineralization period in the Cenozoic is one of the appealing tasks in the current geosciences. The authors would like to dedicate this chapter to presenting the latest achievements in research of Cenozoic magmatic activities and associated mineralization in north Viet Nam, and of the specific geological structures which are directly or indirectly influenced by the formation and evolution of Ailao Shan – Red River Shear zone following India – Eurasian collision.

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