An autochton, recent lateritic deposit in Eastern Tourids: The Buyukbelen (Farasa-Yahyali-Kayseri, Turkey) iron occurrences

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Buyukbelen laterites at 2.5 km southeast of Farasa (Yahyali-Kayseri) village in the west of eastern Tourids are located at the southwest of Attepe (Mansurlu-Feke-Adana) area being the most important hydrothermal iron province of Turkey. In the area, Upper Cretaceous aged Cavdarusagi olisthostrome and Pozanti-Farasa peridotite nappe belonging to Aladag ophiolite sequence, and transgressively overlying Miocene aged conglomerates (Zebil Formation) crop out (Kupeli, 1996). Cavdarusagi olisthostrome contains mainly carbonate and lesser ophiolitic rock blocks and fragments in a matrix of serpentinite, diabase, chert intercalated pelagic limestone-marl-shale, chert and radiolarite, all of which show lateral and vertical transition to each other.

Laterites studied are composed of semi-autochton, a blanket of 5 to 15 m thick lateritic iron crust including also karstic pockets, and surrounding red coloured, thin (0.5–1 m) soil cover. These laterites are observed as an autochton recent weathering zone above chert intercalated clayey limestones of the Cavdarusagi olisthostrome. In the weathering zone, hematite and goethite levels are distinguishable. Hematite part is 5 to 10 cm thick as thin bands exhibiting short lateral continuation. The weathering zone is characterised mainly bay yellowish brown coloured, thick goethite level. In addition to hematite and goethite, reddish rust coloured limonite is also common in the north of lateritic crust where is heavily karstic. Karstic cavities range from a few decimetres to 7 m in diameter. Continuing karst formation within ore mass and development of few karst cycles up to present are observed. A significant part of semi-autochton material formed karst filings has been transported as colloids, and formed colloform goethites observed as thin (1–15 cm) concentric crust and reniform within karstic cavities. Furthermore, thin (1–5 mm tick) veins and laminates of malachite and azurite are also present within reddish rust coloured pelitic material like-soft and earthy mass.

Mineral assemblage determined by XRD method were presented in Table 1. Goethite, which is common ore mineral, is accompanied frequently by hematite, based on ore microscopy and SEM studies. Cu content of host rock played an important role in the occurrence of malachite and azurite (Table 3). Hematites are generally euhedral or subhedral crystals but goethites are fibrous crystal aggregates within reniform, botryoidal and concentric banded structures. It is observed that goethites have grown on euhedral hematite, and sometimes hematites have grown on reniform goethites. These relationships are depend on hydration and dehydration processes, and require humid and arid terms following each other (Trolard and Tardy, 1987).

Geochemical data suggest that ore is significantly enriched in Fe but depleted in Si and Ca relative to the host rock (Table 2). Al, which could not enriched at conditions of weakly acidic-intermediate environment, has been transported away after dissolution. Transportation of Si occurred under conditions of basic environment (Norton, 1973).

TABLE 1. Mineralogical composition of the host rock (limestone+chert), laterite and red soil samples

Samples	Mineral assemblages
Chert	quartz+calcite+opal-CT+amorphous material
Limestone	calcite+quartz+opal-CT+hematite+amorphous material
Laterite	goethite+hematite+ferrihidrit+quartz+illite+kaolinite+malachite+azurite+ amorphous material
Red soil	quartz+montmorillonite+calcite+illite+opal-CT+amorphous material

TABLE 2. Average major element contents (wt.%) of the host rock (limestone+chert), laterite and red soil

Samples	$Fe_2O_3^*$	Al_2O_3	SiO_2	TiO_2	Na_2O	K_2O	P_2O_5	CaO	MgO	MnO	LOI
Chert	4.65	3.06	71.10	<0.09	0.10	0.15	0.13	12.05	0.29	0.10	8.10
Limestone	1.34	3.12	14.34	<0.05	0.21	0.41	0.18	44.05	0.82	0.16	34.72
Laterite	49.71	3.12	30.75	0.14	0.11	0.42	0.24	0.09	0.78	0.11	14.66
Red soil	4.05	7.13	79.49	0.27	0.14	1.34	1.19	1.73	1.35	0.10	3.25

Note: $Fe_2O_3^*$ is total iron. LOI is loss on ignition at 1100°C.

TABLE 3. Average trace element contents (ppm) of the host rock (limestone+chert), laterite and red soil

Samples	Ba	Ce	Cu	Cr	Zn	Co	Y	Ga	Zr	La	Ni	Pb	Rb	Sr	Mo
Chert			200	650											<40
Limestone			26	225											1100
Laterite	746	49	5115	1083	1315	398	15	8	38	33.27	80	3	16	19	
Red soil			250	300							55				135

Note: Th could not be determined in all samples

Laterites investigated have relatively high Cu, Cr, Co, Zn, Ba and Ni, low Ce, La, Th and Zr contents, reflecting partly geochemistry of oceanic crust. However, high SiO_2 and low Al_2O_3 contents suggest a significant role of chert intercalated carbonates in the formation of laterite geochemistry. Buyukbelen laterites resemble those of ultrabasic rocks with high SiO_2, and laterites of basic rocks with low Al_2O_3 contents (Schellmann, 1986). The tendency towards the oceanic crust chemistry may result from the host rock containing ophiolitic rock fragments since it deposited laterally and vertically transitional with ophiolitic rocks, or show trace element enrichment related with directly depositional environment and reflecting the oceanic crust chemistry. Furthermore, Cr, Cu and Mo contents are significantly high in carbonate and especially chert parts of the host rock (Table 3).

Buyukbelen laterites having a reserve of 150,000 tones derived from chert intercalated pelagic carbonates of the Cavdarusagi olisthostrome as a result of lateritic and karstic processes being effective during Plio-Quaternary times.

The carbonate host rock has undergone locally internal karsting, and allowed semi-autochton ore occurrence by reprocessing of previously formed lateritic material, and then deposition.

Red soil mantling the main ore body represents probably a new weathering surface after erosion of some parts of lateritic iron crust, or slowly developing lateritic processes in cherty pelitic levels where insufficient drainage system is present.

References

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