Source and Potential of Heavy Minerals in the Wind Blown Sand of Che-Jam (Torud) Area

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Abstract
Che-Jam' s wind blown sand deposits is about 6 km long and 2 km wide. It is located 90 km southern Shahrood City. The aim of this study was to determine the distribution, concentration and source of heavy minerals in this deposit. About 30 heavy minerals were identified in each separated sample. The maximum concentrations of Rutile and Zircon are 1866 gr/ton and 1020 gr/ton respectively in sample 3. Zircon and Rutile are rounded and sub rounded respectively, which indicates long distance carrying from the source. Calculation of liner correlation coefficient between the two heavy minerals indicates: a) Negative correlation of Magnetite-Hematite that may show oxidation of original Magnetite. b) Positive correlation of Barite–Altered minerals may represent source of hydrothermal volcanogenic Barite. c) Strongly positive correlation of Pyroxene-Amphibole, Rutile-Magnetite, and Illmenite-Pyroxene indicates igneous source. These minerals may have been carried from volcano-plutonic arc of Kuhe Zar-Torud.

Keywords: *Heavy minerals, Zircon, Rutile, Torud.*

1. Geological setting

Che-Jam wind blown sand deposit, which is about 6 km long and 2 km wide, is located 90 km southern Shahrood. It is surrounded by a variety of geological formations. Evaporate deposit is placed northwestern dune. Metamorphic rocks, mica schist and gneiss with amphibolite facies [1], is placed southern dune and volcano-plutonic arc which includes volcanic rocks mostly andesite and intrusive rocks mostly granodiorite [2], is located south western dune. Furthermore, Che-jam' s wind blown sand deposit is surrounded by several carbonate formations.

2. Analytical methods and results

From the crest of duns 10 samples were collected, in the 500m intervals, at the length of deposit. Screened samples below 100 meshes were selected to study. To remove carbonates and iron oxides coatings they were washed by HCl (0.1N) (Table 1). Afterwards, heavy fractions were separated from light ones by Bromoform ($CHBr_3$), which has specific gravity of 2.85 at 20°C. Heavy minerals were grouped in three categories by magnet separator: a) Ferromagnetic grains, b) Paramagnetic grains, and c) Diamagnetic grains. 30 minerals were detected by binocular (Fig. 1) and XRD. The variety of heavy minerals represented in table 2 indicates their volume percentage and their concentration as gram per ton (ppm).

3. Concluding remarks

Irregular shapes of dunes indicate that major wind directions change in seasons, and local climatology data support it. Samples 3, 4, 8, and 9 represent considerable concentration of economic heavy minerals such as Zircon and Rutile (Fig. 2). Heavy minerals concentrations in sample 3 show the most abundance of all (Fig. 3). The existence of heavy minerals such as Zircon, Titanite (Sphene), Hornblende, and Apatite indicates igneous origin [3]. There are accessory minerals such as Titanite, Apatite, Epidote, Rutile, and Zircon in Kuhe Zar-Torud' s volcano-plutonic arc [4] which may have provided the major source of these minerals. Metamorphic rocks at southern area probably generate Garnet and Staurolite although Garnet, an, accidental mineral, exists in granodiorite of volcano plutonic arc [2]. In general most of the heavy minerals in the wind blown sand derived from igneous complex located in southwestern Che-Jam which includes Andesite and Dacit andesite as extrusive, and granodiorite as intrusive [2]. Furthermore, strongly positive correlation of Pyroxene-Amphibole, Rutile-Magnetite, and Illmenite-Pyroxene indicates igneous source. Hematite has strong negative correlation with Magnetite since it may have generated Magnetite oxidation. Strong correlation between Barite and altered minerals indicates hydrothermal veins as its source.

The light minerals which have the most abundance in the Che-Jam wind blown sand are Calcite with 26.5 percent concentration and Quartz with more than 70 percent concentration. They may have been derived from carbonate formations and hydrothermal veins as well as detrital sedimentary rocks around the wind blown sand deposits.

Table 1) Heavy and light fractions in each 25 gram sample.

Sample No.	light minerals (gr)	Heavy minerals (gr)	Heavy fraction in 25 gr
1	23.127	1.77	7.09
2	23.994	0.99	3.98
3	22.71	2.26	9.04
4	23.026	1.97	6.69
5	23.56	1.43	5.72
6	23.422	1.55	6.18
7	23.63	1.36	5.44
8	23.478	1.47	5.86
9	23.75	1.19	4.76
10	24.47	0.53	2.12

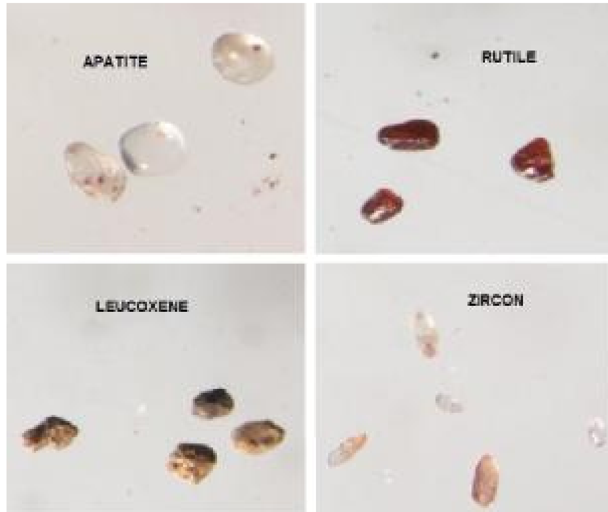

Fig 1) some heavy minerals under binocular.

Table 2) Heavy minerals data in Che-Jam wind blown sand.

Sample no.	1	2	3	4	5	6	7	8	9	10
H.w. in 25 gr	**1.77**	**0.99**	**2.26**	**1.97**	**1.43**	**1.55**	**1.36**	**1.47**	**1.19**	**0.53**
volume H. Fraction	0.6018	0.3366	0.7684	0.6698	0.4862	0.527	0.4624	0.4998	0.4046	0.1802
Ilmenite volume %		0.01	0.01		0.01	0.01				0.45
Ilmenite gram per ton		6	15		9	10				156
Zircon volume %	0.01	0.01	1.32	0.8	0.01	0.01	0.03	1.07	0.55	0.01
Zircon gram per ton	11	6	1866	986	9	10	26	984	409	3
Apatite volume %	0.54	0.01	1.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Apatite gram per ton	416	4	1043	9	6	7	6	6	5	2
Rutile volume %	0.27	0.01	0.79	0.53	0.01	0.81	0.56	0.8	0.55	0.01
Rutile gram per ton	273	6	1020	596	8	717	435	672	374	3
Leucoxene volume %	0.27	0.01	0.79	0.8	0.01	0.81	0.56	0.53	0.03	0.01
Leucoxene gram per ton	227	5	850	750	7	598	363	371	17	3
Sphene volume %	0.03	0.01	0.03	0.27	0.03	0.27	1.41	0.53	2.19	0.03
Sphene gram per ton	25	5	31	246	20	194	887	360	1205	7
Anatase volume %			0.01	0.01	0.03		0.01	0.01		
Anatase gram per ton			12	10	23		7	8		
Cinnabar volume %		0.01		0.01			0.01	0.01		
Cinnabar gram per ton		11		21			15	16		

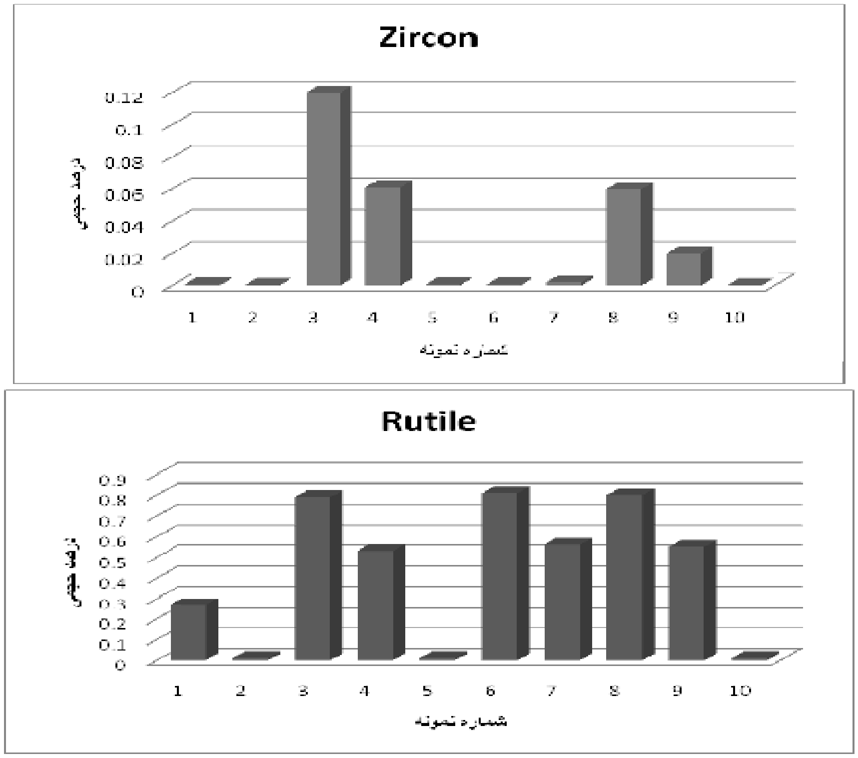

Fig. 2) Rutile and Zircon Concentrations in 10 samples.

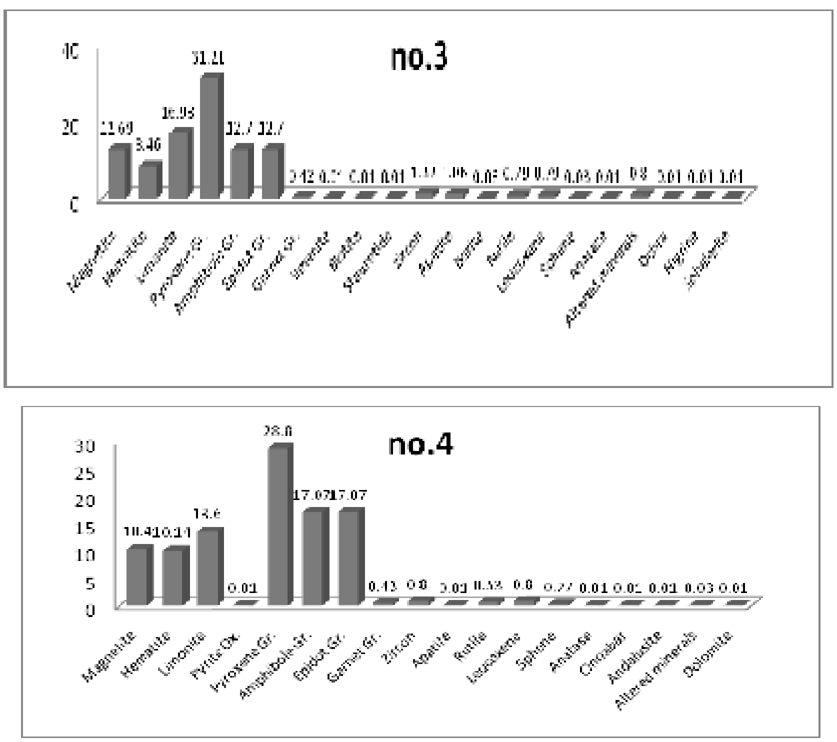

Fig 3) Heavy minerals concentrations in samples number 3 and 4.

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