International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2024 Vol. 14, pp. 81-86/Nurtaev
Research Article

MINERALOGICAL AND GEOCHEMICAL FEATURES OF THE DERBEZ CACHOLONG DEPOSIT (BUKANTAU, UZBEKISTAN)

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ABSTRACT
This article discusses the geological structure and mineralogical and geochemical features of the Derbez cacholong deposit, located in the mountains of Bukantau, Uzbekistan. The study showed a connection between the occurence of cacholong and zeolite-bearing rocks.

Keywords: *Cachalong, Opal, Zeolite, Central Kyzylkum, Bukantau, Uzbekistan*

INTRODUCTION

On the territory of Uzbekistan, the deposits of cacholong and opal are known only in the Kyzylkum region, where they were mined during the Celteminar culture – the period of the late Neolithic and Early Bronze – dating from VI-III thousand BC. The cessation of cacholong mining is the appearance of metal tools.

Opal is one of the most famous jewelry stones. The name opal comes from the Sanskrit stone or noble stone, according to other authors - from the old Sanskrit word "upala" - a precious stone, in Greek it sounded like "opalos", in Latin – "opalus". According to V. Shuman, opal is an amorphous substance; hardness on the Mohs scale is 5.5-6.5. density is 1.96-2.20; color of the feature is white, colorless, gray; cleavage is absent; fracture is cancellous; refraction of opal is 1.44-1.46; cleavage is absent; fracture is cancellous; chemical formula SiO2*nH2O, aqueous silicon oxide. **Cacholong** is a transparent or translucent opal of bluish-white and light color, or a reddish variety of ordinary opal with a low aluminum content. Synonym: kahalong; pearlopal. Cacholong (kahalong) is a mineral, white, enamel–like opal, often with a mother-of-pearl hue. Cacholong got its name from the Mongolian "beautiful stone".

The Derbez cachalong deposit is located on the southern slopes of Bukantau mountains. It was opened in 1980 by Kyzylkum State Geological Expedition (Gerbek, 1984, vol. 3).

RESULTS AND DISCUSSION

A trench has been passed here (length about 60 m, width 10-12 m, side height 3-5 m) oriented in the

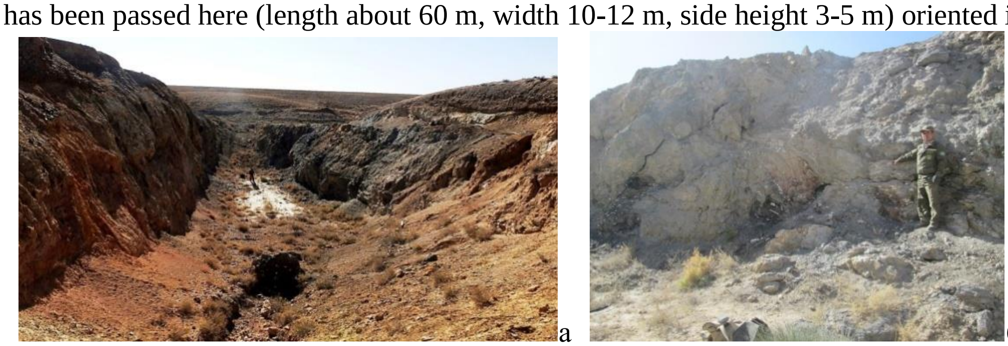
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Figure 1: Trench (a, view from north to south); b-the western wall of the trench with cacholong outlets (light secretions) in the core of the carbonaceous mica shale fold and its subhorizontal lenses (Derbez cacholong deposit, Bukantau mountains).

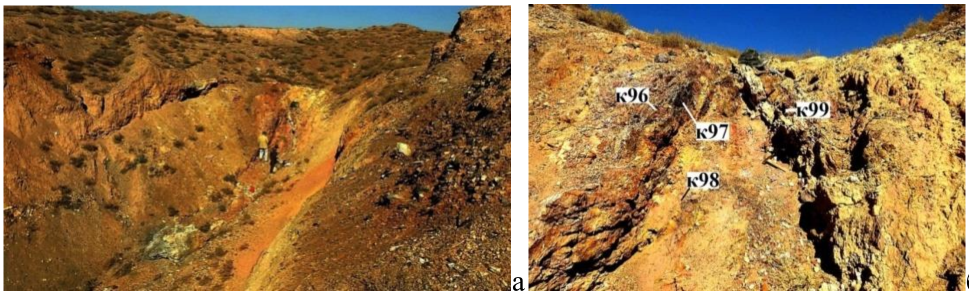

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Figure 2: The exit of the anticline fold at the northern end of the trench (a), the same close-up (b)

meridional direction (Fig. 1a). Siltstones, carbonaceous-mica-quartz shales of the Kokpatass formation R_2kp take part in the geological structure of the deposit. The horizon with a cacholong, which is sub-consistent in siltstones, has a thickness of 30-35 m (Gerbek, 1984).

An anticline fold opens at the northern end of the trench. The azimuth of incidence of the western wing of the fold is 270°, the angle of incidence is 70°, the eastern one is 80°, the angle of incidence is 45° (Fig. 1). The width of the fold at the base is 0.9. In the western wing (thickness about 1.2 m), the folds are exposed to varying degrees of decomposed and oxidized reddish-brown rocks (Fig. 2b - sample K96) with cavities (up to 1.5 x 2 cm) made of small (diameter up to 1.5-2 mm) brownish balls (spherulites) sometimes cemented together. The spherulites, peeled from the brown crust, are light.

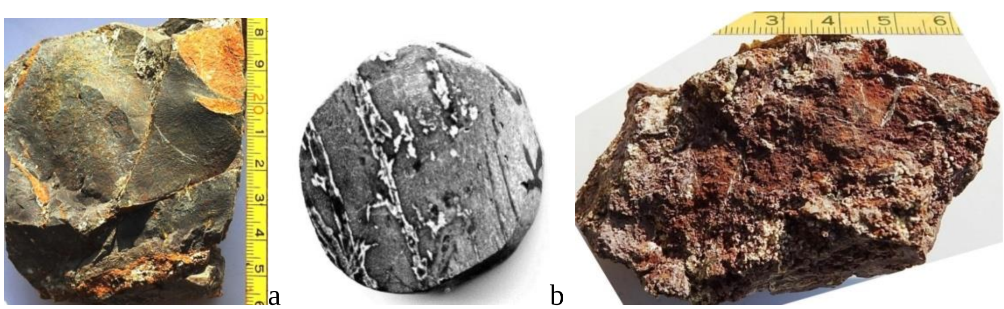

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Figure 3: Zeolite-containing rock unchanged by weathering processes (a – ore, b – the same, polished strip - x2.5 magnification, sample K97), the same oxidized (c – sample K96).

In the central part of the oxidized rocks, a lenticular body (0.3 x 0.9 m) of dense, gray, dark gray, micrograined rocks has been preserved from weathering processes, easily splitting into fragments with a shell-like separation and scratching with a needle with pressure (Fig. 3b - sample K97, Fig. 33a, b). Rocks are split cracks made by reddish-brown crusts of iron oxides. Visually, in the polished section made of this massive rock, subparallel cleavage cracks are visible, along which submillimeter and parallel oriented light colored zones develop (Fig. 3b). In its right part, the rock acquires a pink hue.

The eastern wing of the fold (thickness about 0.8 m) is composed of less oxidized (Fig. 2b-sample K99), but similar in appearance to the rocks of the western wing (Fig. 2b, sample K96). In the central part (core) of the fold, light gray, mica-quartz, lenticular and lamellar (thickness up to 2.5 cm, length up to 15 cm), brittle PR_3 shales with inclusions of cacholong (Fig. 4a - sample K98) are exposed, forming: veins (length up to 0.5 m) consisting of separate or lensing nodules covered with a marshallite crust from the surface (Fig. 4b-c), irregular plates (up to 2.5 cm thick) covered with crusts of oxidized shales (Fig. 4c).

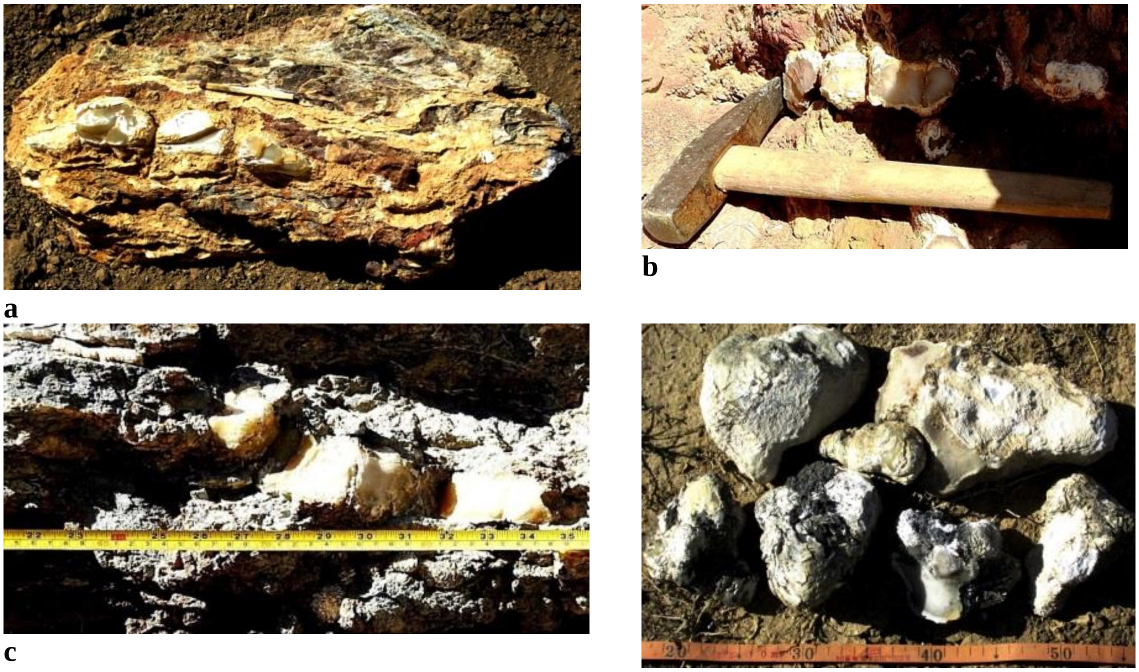

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Figure 4: Cacholong nodules in weathered shales (a, sample K98, fig. 2. 54b); the same from the base of the eastern wing of the fold under sample K99 (Fig. 3.54b); the same from the outcrop in the western wall of the trench (c); the same from the dump of rocks at the bottom of the trench (d).

The predominant form of finding a cacholong at the deposit is a nodule, its individual specimens reach 10x15x24 cm and weight up to 8 kg (Fig. 3.56 g, 3.57).

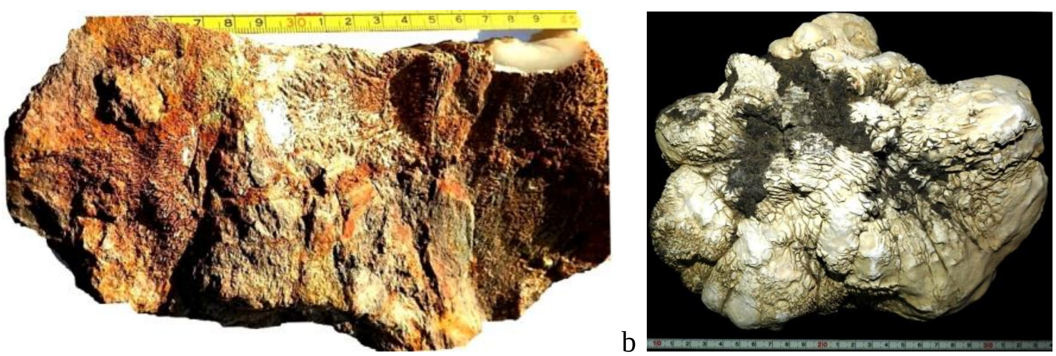

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Figure 5: The lens is a prepared caholong plate in shales from the core of an anticline fold (a), a groove covered with a crust of marshallite from a rock dump (b).

A preliminary study of samples K97 and K96, as well as all relict light, light gray areas and spherulites from the K96 model revealed their weak acid resistance, which is a characteristic feature for zeolite-containing rocks and zeolites from the analcime-natrolite group. When viewing the polished section under a binocular magnifying glass, it was found that dense gray areas of the rock are dotted in places with the smallest (fractions of mm) light secretions, the number of which increases sharply in light subparallel bands (Fig. 3.55-c). Further study of these samples was carried out on a microprobe.

The study of the polished section (sample K97) on the JHA-8800Rh microprobe showed that dense gray areas of the rock (Fig. 3.72) have a cryptocrystalline composition, riddled with numerous microcracks and

micro-voids of leaching; they underwent recrystallization processes with the formation of a microneedle aggregate (Fig. 3.72a, left part of the figure). According to the analysis, the rock contains variable amounts of the main components (Tables 1, No. 14, 16, etc.), which is associated with the constant presence of Fe_2O_3. And only in two point measurements (No. 18, 1), their chemical composition corresponds to analcime (Table 1, No. 30).
The analcime-containing rock contains inclusions of: rare lenticular (length up to 1 mm, thickness up to 150 microns) ytterbium-containing (Yb_2O_3 1.00%) calcite corroded by the main sodium-containing mass (Fig. 5a); vanadium-containing rutile (TiO_2 61.56-97.20; V_2O_5 1.59-2.26%) and phosphates of rare earth minerals (REM), often -Ce_g and rarely - Y_g groups (Table 1).

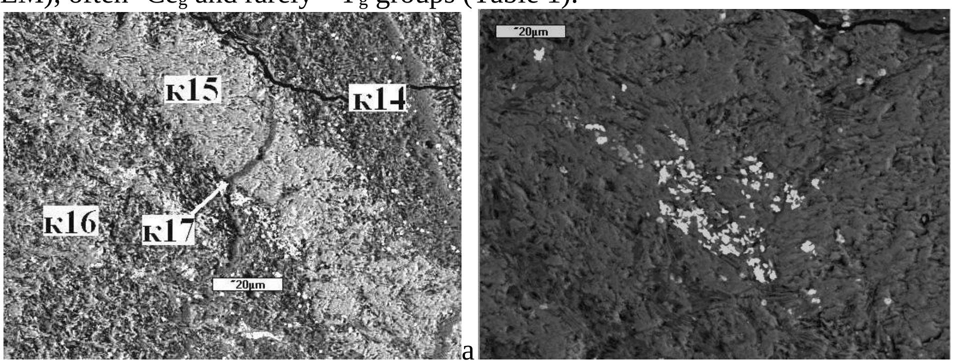

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Figure 6: A. Zeolite–containing rock (k14, k16) with a calcite lens (k15), contains inclusions of $REMY_g$ (17) and frequent iron oxides (bright spot secretion). B. Massive zeolite-containing rock (dark gray) with inclusions of grains: rutile (gray), $REMC_{eg}$ (bright light) and iron oxides (small bright)

Table 1: Content of components in zeolite-containing rock (sample K97, the Derbez cachalong deposit, Bukantau mountains) (wt. %)

Compo-nents	Analysis #							
	14	16	18	19	5	1	4	7	30
Si_2O	49.87	50.76	56.95	14.96	34.39	56.12	47.03	16.77	54.47
Al_2O_3	25.50	27.69	23.00	14.13	14.99	19.02	25.44	9.64	23.29
Na_2O	5.98	6.44	13.37	8.60	7.23	14.22	11.84	2.96	14.07
K_2O	-	1.37	2.23	-	0.85	-	5.64	-	n.d.
CaO	1.37	0.55	1.61	1.26	0.95	1.25	0.91	0.82	
Fe_2O_3	0.70	0.77	0.83	-	31.27	0.87	1.84	50.79	
FeO	n.d.	n.d.	n.d.	13.79	n.d.	n.d.	n.d.	n.d.	
TiO_2	-	-	-	24.14	-	-	-	0.41	
V_2O_5	-	-	-	0.61	-	-	-	0.37	
H_2O	n.d.	n.d.	n.d.	н. оп.	n.d.	n.d.	n.d.	n.d.	8.01

Note. Analysis numbers: 14, 16 (Fig. 3.72 a); 18, 19-left and right parts of Fig. 3.72 b.
Analyses: 5, 14, 16, 18, 19 – dense zeolite secretions; 1 – dense secretion framed by needle–like grains (Fig. 3.73b); 4, 7 – the same needle-like grains; 30 - chemical composition of analcime according to E.K. Lazarenko (p. 344, 1971). N. d. – not determined; the dash - below the sensitivity of the analysis.

In the process of hypergenic exposure, neoplasms in the form of needle-like (Fig. 7), spherulite (initial stages of recrystallization) aggregates with frequent inclusions of iron oxides (Fig. 3.73b) and culminating

in complete decomposition of zeolites with the formation of cacholong (opal) (Koldaev, 1973, 1974, 1989).
REM, mainly phosphates of rare earth elements (REE) Ce, approach monazite in terms of the amount of oxides (Table 2, No. 13), form tabular (1x5 microns), irregular (5x6 microns) grains, their clusters (up to 10x12 microns); REMY$_g$ in the form of single rounded grains (2x2 microns) can be attributed to the xenotim (Table 2 , No. 17).

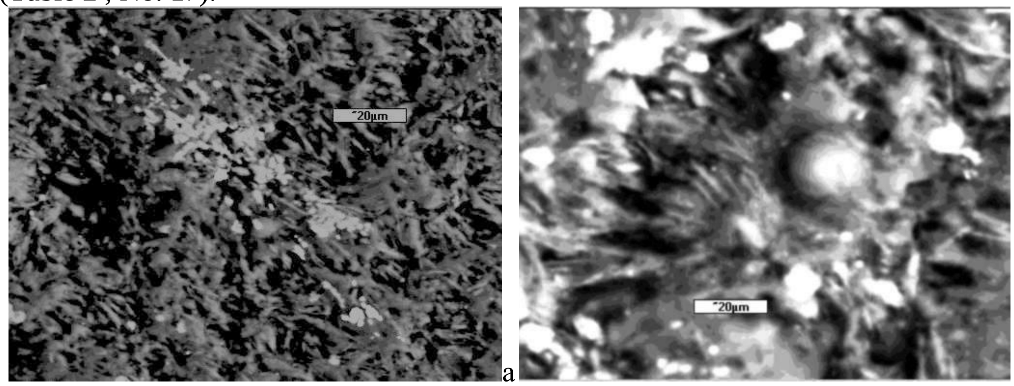

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Figure 7: Needle-like (a, b), non-spherulite and sheaf-shaped (b) new formations of analcime. A. Inclusions: rutile (gray), REMCe$_g$ phosphates (the brightest and largest, Table 2, No. 9, 10; CuO contents 0,05-1,94%), iron oxides (fine light ones). B-flakes of iron oxides (bright) among massive, needle-like and spherulite analcime secretions.

Table 2: The content of Ce$_g$ (9, 10, 13, 21) and Y$_g$ (17) elements in phosphates of rare earth minerals (wt. %)

Components	**Analysis #**				
	9	10	13	17	21
SiO_2	12.46	9.91	1.15	10.16	-
Al_2O_3	5.15	4.93	0.74	7.50	-
K_2O	-	-	0.97	0.62	-
Na_2O	11.34	7.63	-	-	-
CaO	0.68	1.27	-	1.74	3.05
Fe_2O_3	2.65	1.50	1.01	-	-
SO_3	4.28	0.60	-	-	-
CuO	1.94	0.05	-	-	-
P_2O_5	21.79	23.97	25.02	35.12	24.11
La_2O_3	11.28	9.68	14.12	-	14.90
Ce_2O_3	23.52	23.55	26.62	-	29.72
Pr_2O_3	1.04	1.90	1.66	-	2.15
Nd_2O_3	8.94	10.21	10.66	-	10.05
Sm_2O_3	1.70	1.20	1.66	-	1.07
Gd_2O_3	1.11	1.04	0.94	-	1.43
Dy_2O_3	-	-	-	4.50	-
Go_2O_3	-	-	-	0.83	-
Yb_2O_3	-	-	-	2.15	-
Er_2O_3	-	-	-	2.82	-
Y_2O_3	-	-	-	32.67	-
ΣREE	47.59	47.58	55.66	42.97	59.32

CONCLUSION

Thus. the new discovery of zeolite-containing low-temperature metasomatites and their decomposition to form kacholong (opal) confirms the ideas of A.A. Koldaev (1973; 1989. 2018) about the genesis of the latter with hypergenic changes in zeolite-containing rocks. The search for new occurences of zeolites in the deposits of cacholong (opals) in the Central Kyzylkums will be based on these provisions.

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