ISSN 1028-334X, Doklady Earth Sciences, 2006, Vol. 410, No. 7, pp. 1080–1082. © Pleiades Publishing, Inc., 2006.
Original Russian Text © A.Kh. Khasanov, 2006, published in Doklady Akademii Nauk, 2006, Vol. 410, No. 1, pp. 106–108.

GEOCHEMISTRY

New Data on the Carbon Isotopic Composition and Genesis of Mumie

A. Kh. Khasanov

Presented by Academician A. A. Marakushev October 24, 2005

Received December 19, 2005

DOI: 10.1134/S1028334X06070178

The history of using "mumie" (mountain oil or algarite) as a medical remedy in traditional eastern medicine is rooted deep in the ages. This legendary natural balsam, also called the life elixir, has been popular for many centuries in many countries, especially in India, China, Myanma, Vietnam, Pakistan, Afghanistan, Iran, Turkey, Syria, and Egypt. It was also widely known in Central Asia, Kazakhstan, Transbaikalia, and the Caucasus. This exotic eastern medical remedy came to Russia and other European countries later. Hippocrates, Aristotle, Discurdius, Galen, Al-Biruni, Ibn Sina (Avicenna), and others wrote about mumie and applied it in their practice.

Interest in mumie has been revived in recent years for many reasons but mainly because of its antiseptic, antiphlogistic, regenerative, antiradiation, protective-adaptive, and other properties. This is evident from numerous publications devoted to different aspects of mumie [1–12 and others]. Some works are dedicated to the most detailed description of the geochemistry and other features of this substance, while others [1, 2, 6] are devoted to the description of its medicinal properties.

At present, mumie has been found in many regions of the world, including CIS countries. This substance is most widespread in the mountainous regions of Central Asia, particularly within the Pamir and Hissar–Alai regions. Mumie is usually found among massive weathering-resistant rocks exposed in the topography. These rocks are mainly represented by fissured, silicified, and marbleized limestones and dolomites, and less common quartz–sericitic schists, quartzitic sandstones, mylonitized compact granitoids of different (Archean–Proterozoic, Paleozoic, and Meso–Cenozoic) ages. Mumie is confined to karstic and tectonic caves, cracks, and other dissolution cavities in fault zones with a wide development of cataclasm and mylonitization of rocks.

Tajik State National University, Dushanbe, Tajikistan
e-mail: thass@mail.ru

Mumie is commonly observed as a coating and overgrowth on rock fragments, product of vital activity of small rodents, birds, plant remains, as well as films, sinters, and stalactite-type congelations along walls and niches in caves and cavities. It also forms thin veinlets among the rocks mentioned above. The contents of mumie and its components in rocks demonstrate a wide variation range. The study of its composition in the region under investigation shows that it consists of the mixture of high-ash mineral (up to 50 wt %) and organic (50–90%) components and a complex of microelements. According to [3–15], including our data on samples mentioned in the table, the mineral part includes the following elements (wt %): carbon (31.8–54.04), hydrogen (2.14–6.20), nitrogen (5.0–7.18), sulfur (0.20–3.84), oxygen (33.03–58.80), potassium (9.13–18.93), calcium (2.20–7.29), magnesium (5.5–7.0), silicon (1.53–4.03), aluminum (1.34–1.54), manganese (0.16–0.3), phosphorus (0.038–0.1), strontium (0.06–0.07), and barium (0.04–0.07). The considerable scatter of the contents of elements is governed by types and later changes in the mumie, the composition of host rocks, their subsequent pollution, and so on. The analysis of mumie by different modern methods has made it possible to detect more than 40 microelements, such as Cu, Ni, Co, Cr, Rb, Be, Li, Mo, Zn, W, Cd, In, Sn, Ti, Hg, Sb, Pb, B, Br (~25 mg/kg); As, Ag, V, Te, Ga, Gd, Zr (>5 mg/kg); and Au, Ir, Bi, Sc, Se, Cs, Hf, Y, Yb, and Eu.

These elements are among the factors of medicinal properties of mumie. They occur as ultrafine dispersion of minerals of different classes, electroneutral element microparticles, and organometallic compounds. All the studied mumie samples demonstrate luminescence with different intensities in short- and long-wave ultraviolet rays. The grayish yellow luminescence is characterized by orange, violet, and greenish tints. However, the samples do not show any residual luminescence (phosphorescence) or luminescence in cathode rays (i.e., when excited by accelerated electrons). Studies of chloroform and alcohol–benzene extracts from mumie

Carbon isotopic composition of mumie

Ord. no.	Sample no.	Sampling site	$\delta^{13}C$, ‰	Source
Central Asia, Tien Shan				
1	4	Turkestan Range, Kyzoke River	–24.30	Khasanov [12]
2	4A	The same	–25.49	The same
3	2A	Hissar Mts., Tagobi-Kul River	–26.80	"
4	3	", Shink River	–24.30	"
5	23	", Tagobi-Kul River	–23.95	"
6	1	", Iskandar-Kul River	–25.13	"
7	30	", Voru River	–24.55	"
8		Zeravshan–Hissar region	–25.20	Pankina et al., [10]
9		The same	–29.80	The same
10		"	–20.10	Yusupov and Galimov [7]
11		"	–24.80	The same
12		"	–22.90	"
13		"	–23.50	"
14		"	–24.80	"
15	51	"	–25.00	Kodina et al., [9]
16	50	"	–25.40	The same
17	47	"	–25.60	"
18	10	"	–26.10	"
19	15	"	–24.60	"
20	16	"	–24.00	"
21	11	"	–27.20	"
22	28	"	–25.30	"
23	9	"	–26.10	"
24	169B	"	–22.40	Galimov et al., [11]
25	165	"	–24.70	The same
26	270	"	–24.40	"
27	182A	"	–24.80	"
28	64(1)	"	–24.00	"
29	64(2)	"	–24.60	"
30	72(1)	"	–23.70	"
31	72(2)	"	–26.00	"
Central Asia, Pamir				
32	15	Eastern Pamir	–24.00	Kuleshov (1985)
33	22	South Alichur Ridge, Gurumdy River	–22.69	Khasanov [12]
34	11	The same	–23.01	The same
35	24	"	–25.70	"
36	13	Bazardarin Ridge	–25.60	"
37	14	The same	–26.01	"
Central Kazakhstan				
38	B-17	Central Kazakhstan	–24.90	Kuleshov (1985)
39	636	Eastern Kazakhstan (Altai)	–23.80	The same
Afghanistan				
40	9		–24.60	Khasanov (1991)
41	6		–23.13	The same
Northern Caucasus				
42		Alagir Gorge	–29.10	
43		The same	–27.30	Katchenkov (1969)

samples unambiguously point to the presence of a series of organic substances, which did not undergo substantial diagenesis. They include complex organic compounds of the plant and animal origin.

Despite the ancient history and numerous publications, the origin of mumie remains a debatable issue. The comprehensive scientifically substantiated concept of its nature is now in the development stage. In the course of recent studies of mumie with the aim of obtaining additional genetic information, we carried out chemical, geochemical, and luminescence–bituminological investigations of this substance. We also determined the carbon isotopic composition in mumie from different regions of Central Asia, Kazakhstan, and Afghanistan. The data obtained along with analogous materials of other researchers are presented in the table.

According to these data, the carbon isotopic composition ($\delta^{13}C$) in mumie shows the following variation range:–20.10 to –29.80‰ (average –24.9‰ in southern Tien Shan (Zeravshan–Hissar region); –22.69 to –26.01‰ (average –24.5‰) in Pamir; –24.5‰ in Kazakhstan; –24.85‰ in Afghanistan; and –28.2‰ in the Northern Caucasus. Thus, one can see that, despite the great distances between sites of mumie occurrence, differences in their morphological and structural features, and the composition of host rocks, the carbon isotope relations in mumie from Central Asia, Kazakhstan, and Afghanistan are similar. They lie in a very narrow range from –24.9 to –24.5‰, which is indicative of a single source of parent materials and common subsequent geochemical and biochemical alterations [12]. A slightly lighter carbon isotopic composition in mumie from the Northern Caucasus (average –28.20‰, as compared to –24.69‰ in other areas) seems to be related to some specific physicochemical and climatic conditions in this region.

Comparative analysis [12] shows that values of the carbon isotopic composition in mumie from Central Asia and Kazakhstan are similar to isotope values in the organic material of marine sediments (average $\delta^{13}C$ = –24.0‰), biogenic carbon of metasedimentary rocks, particularly, the Yagnob Formation of Southern Tien Shan ($\delta^{13}C$ from –25.6 to –22.1‰, carbon of causthobiolites ($\delta^{13}C$ = –24.8‰) and humic materials, carbon dissemination in igneous rocks (average $\delta^{13}C$ = –22.7‰, and organic compounds and aminoacids of land plants [9]. Some authors [7, 10] believe that present-day highland plants could participate in the formation of mumie and do not support its oil origin. Based on the geological conditions of mumie occurrences, its spatial distribution, and other available materials, the author of the present paper suggested an endogenic origin of mumie in the course of complex multifactor transformations of elementoorganic compounds of deep-seated fluids. The confinement of mumie to near-surface caves and cavities indicates that they serve as traps for deep-seated fluids due to sharp changes in thermodynamic conditions and decay of juvenile elementoorganic compounds of fluids and separation of hydrocarbons (the basic components of mumie). Taking into consideration the chemistry and saturation of mumie with diverse organic compounds that are formed in the course of biochemical processes, we may assume substantial microbiological fractionation and a decrease in the concentration of heavy isotopes of endogenic carbon related to deep geological–geochemical processes.

REFERENCES

1. Kh. R. Rasulov, Med. Zh. Uzbekistana, No. 6, 80 (1964).
2. A. Sh. Shakirov, *Mumie-acil in the ComplexTreatment of Bone Fractures* (FAN, Tashkent, 1976) [in Russian].
3. S. B. Davidyants, L. N. Kirichenko, L. V. Mel'nikova, et al., Dokl. Akad. Nauk Tadzh. SSR **9** (5), 15 (1966).
4. N. P. Tuaev, V. N. Petrov, and S. M. Katchenkov, Tr. VNIGRI, No. 279 (1969).
5. K. F. Blinova, N. V. Syrovezhko, and T. P. Yakovlev, Priroda, No. 3, 82 (1972).
6. Yu. N. Nuraliev and P. P. Denisenko, *Mumie and Its Medicinal Property* (Irfon, Dushanbe, 1977) [in Russian].
7. R. G. Yusupov and E. M. Galimov, in *VII All-Union Symposium on Stable Isotopes in Geochemistry* (GEOKhI, AN SSSR, Moscow, 1978) [in Russian].
8. R. G. Yusupov, D. D. Dzhenchuraev, and Sh. Khatamov, Geokhimiya, No. 10 (1979).
9. L. A. Kodina, L. N. Vlasova, I. D. Shevalevskii, and Z. N. Khakimov, in *II All-Union Conference on Carbon* (Nedra, Moscow, 1986) [in Russian].
10. R. G. Pankina, V. L. Mekhtieva, and S. M. Gurieva, Geol. Nefti Gaza, No. 8 (1989).
11. E. M. Galimov, L. A. Kodina, L. N. Vlasova, et al., Geokhimiya, No. 10 (1986).
12. A. Kh. Khasanov, Dokl. Akad. Nauk Tajikistan **36** (4/5), 315 (1993).