OPAL VARIETIES IN CARPATHIAN VOLCANIC ROCKS

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A fair amount of water is a typical constituent of opal, a short range order form of silica. Opals are distinguished by structural attributes (opal-A, -C, -CT); their name may vary by colour (milky and black opal, chrysopal), by transparency (hyalite, hydrophane, cacholong) or by gem value (common and noble opal). There is no opal classification based upon the water content, though it varies from 1 to 30%. We do not have enough information about the role of water in opal, not speaking about the amount and role of other volatile components present.

Gas analysis of pyrolysed opal showed that during heating not only the dominant water (vapour), but also hydrogen and volatile compounds of carbon (CO_2, CO, CH_4, C_nH_m) leave the samples. While degassing, many opal samples generate compounds of nitrogen (N_2, NO), and some of them also compounds of sulphur (H_2S, SO_2, COS). The amount of non-water phases in the leaving gas mixtures decreases from the opaque to the transparent opals. (causing a reverse dependence for water).

In the current study we analysed the gas composition of different opal varieties and that of their volcanic parent rocks (from the Carpathians) on heating and compared these results with analyses of opals from the Ukrainian Shield (Table 1).

The two opals from the Ukrainian Shield gave interesting results (PAVLYSHYN *et al.*, 1993; KULCHYTSKA *et al.*, 1997). They are closely connected, form a zonal structure. Their non-volatile chemical composition do not differ, while their volatile composition differ considerably. The differences in the volatile composition were interpreted in the following way: The "amorphous" silica contains open or closed pores. Opals with open pores contain less water than opals with closed pores. In the first case water is considered as „adsorbed", while in the second case as "absorbed" (in the vacuole). Typical characteristic of opals with open pores is a fair amount of carbon compounds and hydrogen in its pyrolysed gas. The different composition of volatile admixtures on the surface of silica globules was suggested to lead to the formation of two opal varieties, called "hydroxyl-opal", with OH-groups, and "organo-opal", with CH-groups, respectively.

These two opal varieties were found also in Carpathian volcanic rocks, but separately. Opal present in altered tuffs (Table 1, #5) resembles "hydroxyl-opal" the most, as vacuole water dominates in it and there are very little hydrocarbons present. "Ungvarite", a mixture of opal and nontronite (Table 1, #6), is similar to them, too. Precious opal from Dubnik (Table 1, #2–3) is similar to "organic-opal" in the amount of hydrocarbons. On the other side the larger amount of "absorbed" and the fewer amount of "adsorbed" water in it gives us the reason to interpret that variety as a mixture of "hydroxyl-" and "organic-opal". Kinetics of water separation suggests the very small size of both the open and the closed pores. The amount of hydrocarbons, and also CO_2 and particularly CO decreases noticeably. from the translucent to the vitreous variety. The similar trends of changing of the CO, C_nH_m and H_2 content suggests the common source of these compounds.

Based on the data of the parent rocks (Table 1, #1, 4) it can be pointed out that 1) there is an inverse correlation between the amount of organic groups in opal and in its (volcanic) parent rock; 2) there is much nitrogen in the pyrolysed products of volcanic rocks, even without adsorbed nitrogen. (up to 0,005%).

To our point of view the differentiation of silica (caused by temperature and pressure changes), the formation of the opal varieties, was influenced also by the composition of these volatile admixtures.

References

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Table 1: The amount of some components in the pyrolysed products of opals and their parent rocks.

	Temp. of pyrolysis (°C)	1	2	3	4	5	6	7	8
H_2O (wt%)	50–1050	3.60	3.59	3.45	6.67	7.26	6.65	1.49	4.95
	50–250	0.72	0.85	0.32	0.86	0.54	1.18	1.06	0.26
CH_4 (ppm)	50–1050	0.53	7.30	4.35	54.98	0.13	0.53	7.73	0.87
C_2H_4+C_2H_6(ppm)	50–1050	0.38	16.50	2.94	64.70	1.03	0.10	16.00	1.30
N_2 (ppm)	250–1050	17.44	7.09	16.16	49.12	9.39	7.13	4.22	1.07
No. of analyses		*1*	*3*	*1*	*2*	*3*	*2*	*11*	*18*

1) andesite, Dubnik, Slovakia; 2) milky and frost opal (from andesite), Dubnik, Slovakia; 3) vitreous opal from andesite, (from andesite), Dubnik, Slovakia; 4) altered volcanic (crystal/vitritic) tuff, Slovakia; 5) translucent opal from altered volcanic tuff, Slovakia; 6) „ungvarite" (opal-nontronite intergrowth), Transcarpathians, Ukraine; 7) „organo-opal", the Ukrainian Shield, Ukraine; 8) „hydroxyl-opal", the Ukrainian Shield, Ukraine.