The Divnoe meteorite. III. Bulk chemistry

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The Divnoe slice of 1.5 x 3.0 x 0.4 cm in size and 3 separate chips was used for chemical analysis. The samples have had visible terrestrial oxidation and relatively high content of fine metal. Meteorite was analyzed using traditional technique [1]. Alkalies, carbon and connected water were determined from separate subsamples. Major elements were determined by X-ray fluorescence, atomic absorbtion and ICP methods and contents of water and carbon were measured using CHN-analyser. The results of analyses of 5 subsamples and their weights are presented in Table 1.

The analyses of 4 small subsamples differ from much of meteorites in low Al_2O_3 content which is similar with nakhlites and chassignites only [2]. But in contrast to these meteorites contents of Na and, especially K in Divnoe are so high that the standard norm calculation gives high orthoclasic feldspar which are not observed in the meteorite. Moreover, Na/Al ratios of subsamples investigated vary in the wide ranges of 0.26 - 3.9 and 2.03 - 9.95, respectively, implying essential variations in contents of several minerals bearing these elements. This may be resulted from whether inhomogeneous distribution of alkalies and Al throughout meteorite since these elements in addition to plagioclase constitute also clinopyroxene, chromite and whitlockite or terrestrial contamination of meteorite by Na and K.

This dilemma may be solved using norm calculations based on measured mineral compositions. The sequence of calculations is chromite (from bulk Cr_2O_3), whitlockite (from bulk P_2O_5), plagioclase (from rest Al_2O_3), clinopyroxene (from rest CaO) and olivine + orthopyroxene with the same Fe/(Fe + Mg) ratio. In this calculation measured contents of Na_2O and K_2O aren't used and contents of Al_2O_3 in pyroxenes and CaO in orthopyroxene may be ignored. The results of such calculation are listed in Table 1. Fe/(Fe + Mg) ratios of olivine and orthopyroxene are close to values measured in the Divnoe minerals and the plagioclase contents don't exceed its abundance in plagioclase-rich section [3]. Based on norms of plagioclase, clinopyroxene and whitlockite - major minerals containing Na and K - it may be estimated Na_2O and K_2O contents of subsamples analysed: I - 0.14 and 0.002; II - 0.13 and 0.002; III - 0.092 and 0.0007; IV - 0.068 and 0.0006; V - 0.080 and 0.0006 wt.% Na_2O and K_2O, respectively. It is widely known from analytical practice that determination of such low abundances of alkalies is very nard and follows by large uncertainties. Nevertheless, in the subsamples II, III and IV calculated and measured contents of Na_2O are close and the degree of terrestrial contamination is probably low. At that time the differences between calculated and measured K_2O contents are about 2 orders of magnitude and indicate substantial K contamination of the meteorite. Since the meteorite has been found on agricultural field source of K was probable to be potash fertilizer. Taking into account the contamination of meteorite in alkalies we have accepted calculated Na_2O and K_2O contents of largest subsample since analyses of several aliquots of this subsample have given high contents of Na_2O and K_2O which are in disagreement to each other.

Aliquots of subsamples No I, IV and V and small chip of the Divnoe were analyzed by INAA. The obtained data on aliquots of relatively large subsamples are in agreement to each other and differ slightly from data on small chip. Among data obtained REE patterns are most interesting. Bulk samples and separate chip differ both in absolute abundances and in distribution of HREE which are indicative of various contents of plagioclase and olivine(+ pyroxene) in samples studied. But it is more important that all the samplcs are depleated in REE relative to chondrites and fractionated with clear positive Eu anomaly.

REE pattern of Divnoe differs from chondrites and most differentiated meteorites both in REE distribution and their absolute contents [4]. Comparable REE contents are observed only in unbrecciated diogenites Y-74010, -74013, -74136 [3] which like Divnoe are granoblastic and contain shock-recrystallized lithology. These diogenites are probably individuals of a single fall [6]. However, the distribution of REE in Divnoe is quite different than in Yamato diogenites that is in good agreement with mineralogical differences between thesc meteorites.

References: [1] D'yakonova M.I. et al. Chemistry of meteorites, 1979, Nauka (in Russian). [2] Dodd R.T. Meteorites, 1981, Cambridge Univ. Press. [3] Zaslavskaya N.I., Petaev M.I., this volume. [4] Kolesov G.M. Meteoritika, 1977, No 37, 112-128 (in Russian). [5] Masuda A. et al. Mem. Nat. Inst. Polar Res., Spec. Issue, 1979, No 15, 177-188. [6] Takeda H. et al. Mem. Nat. Inst. Polar Res., Spec. Issue, 1978, No 8, 170-184.

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Table 1. Chemical and normative composition of Divnoe (wt. %)

Component	I	II	III	IV	V
Sp.wt.,g	.7861	.8004	.8159	.6430	3.3809
Magn.fr.,%	14.21	8.34	12.87	6.44	16.13
Nonmagn.,%	85.79	91.66	87.13	93.56	83.87
SiO_2	32.27	34.26	32.95	36.58	35.37(a)
TiO_2	.023	.015	.017	.014	.027
Al_2O_3	.67	.55	.40	.25	.29
Cr_2O_3	1.47	.87	1.09	.53	.65
FeO	13.16	15.91	16.92	15.71	17.48
MnO	.37	.39	.37	.42	.31
MgO	26.31	27.68	26.86	29.36	28.78
CaO	1.13	1.09	1.63	1.00	1.51
Na_2O	.28	.158	.07	.083	0.080(b)
K_2O	.069	.090	.058	.049	0.0006(b)
P_2O_5(c)	.08	.06	.09	.13	.06
H_2O^-	-	-	-	-	.95
H_2O^+	-	-	-	-	.99
S	2.64	2.16	2.26	2.29	1.60
FeS	4.63	3.76	3.93	3.98	2.78
Fe(met)	13.40	8.48	11.47	7.61	8.09
Ni	1.09	.66	.91	.57	.615
Co	.091	.056	.078	.047	.050
Cu	.003	.002	.002	.002	.003
Fe,Ni	14.58	9.20	12.46	8.23	8.76
C	-	-	-	-	.09
Total	97.686	96.191	99.105	98.634	99.72
Fe(tot)	28.26	24.61	27.07	23.81	24.46
Met	14.58	9.20	12.46	8.23	8.76
Trl	7.27	5.92	6.19	6.28	4.38
Chr	2.74	1.66	2.06	.98	1.24
Cpx	3.42	3.35	5.32	2.94	5.07
Opx	17.66	17.43	11.08	24.34	14.57
Ol	49.99	58.18	59.65	54.15	62.94
Pl	2.21	2.15	1.08	.87	.93
Whit	.10	.08	.12	.18	.08
H_2O	1.94	1.94	1.94	1.94	1.94
C	.09	.09	.09	.09	.09
Fe/(Fe + Mg)	.211	.240	.258	.231	.253

a - determined by weight method
b - calculated from norms of Pl, Cpx and Whit
c - X-ray fluorescence of nonmagnetic fractions