THE ABUNDANCES IN THE STELLAR ATMOSPHERES IN THE M13 GLOBULAR CLUSTER

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ABSTRACT.The chemical composition of 5 stars' atmospheres in globular cluster M13 and 2 halo stars taken from literature have been computed. A slight excess of O and deficit of Mg have been defined for globular cluster stars. The elements Si,Ca,Ti are overabundant (≈ 0.3 dex), Ni is slightly deficient (–0.08), Mg – more deficient (–0.3), Y – slightly overabundant. Comparison with halo stars showed the difference in composition of Na, Mg and elements of r–, s– processes.

Key words: globular cluster, stars, chemical composition.

1. Introduction

Still at earlier stages of photometric investigations of stars in the globular clusters, a difference in intensity bands of CO and CN for the stars with close temperatures and luminosities (in the same cluster) was noted. For example, stars in the globular cluster, ω Cen, are distinctly disintegrated into two sequences of CN–strong and CN–weak stars (Francois et al. 1988); differences in intensities of CN bands are observed for M13 (Lehnert et al. 1990) etc. Spectral investigations of stars have shown differences in abundances of O,Na,Al, anticorrelation between the O abundance and that of the Na, Al and correlation between the Na,Al abundances and CN intensity bands (Suntseff 1981; Wallerstein et al. 1987).

For the elements of α –process (Mg, Si, Ca, Ti), a greater excess (0.4 dex) has been found relative to iron as compared to the Sun than that in similar halo stars (Gratton and Sneden 1987). Elemental abundances of r–,s– processes are also different from star to star.

The aim of this work is to plot curves of elemental abundances in the stars' atmospheres in the M13 cluster, to analyse dependencies between chemical composition of elements and to compare those with abundance curves for halo–stars.

2. Observational material

As observational data we have used equivalent width of lines measured in spectra of stars from (Cohen 1978; Luck and Bond 1985).

Model parameters of the stars and photometric indices are given in Table 1.

3. The determination of abundances

Elemental abundance in the atmospheres of stars under the study was determined with the computer program WIDTH–6 by Kurucz and adapted for IBM PC by V.V.Tsymbal and Yu.Yavorsky.

For all the elements solar oscillator strength log gf were used from Gurtovenko and Kostyk (1989). Model atmospheres were taken from Bell et al. (1976). Solar elemental abundances were determined in the same system.

In Table 2 are given results of our determinations for 5 stars from the globular cluster M13, 2 similar halo giants and for Sun too.

4. The discussion of results

a) CNO and light metals.

It is of interest to compare the O abundance obtained for the investigated stars with CN intensity bands. Unfortunately, the values of intensity bands are only known for two (I–13 and III–73) out of five stars. They show average CN values (1.32 and 1.296) close to each other and close to O abundance values.

The matter is still worse with Na and Al. There is only "traces" of the Na line in one star, so we can't take advantage of this qualitative estimation. In the work by Wallerstein and Leep (1987), the star III–63, in which we

Table 1. Main characteristics of the stars.

*	T_{eff}	log g	[Fe/H]	v_t	B–V	CN
M13	–	–	–	–	–	–
B–140	4000	0.5	–1.5	2.0	–	–
IY–25	4000	0.5	–1.5	2.2	–	–
I–13	4250	0.9	–1.5	2.0	1.25	1.321
III–63	4200	0.7	–1.5	1.5	–	–
III–73	4300	0.8	–1.5	2.0	1.27	1.296
HD103036	4250	0.8	–1.5	2.0	–	–
HD135248	4250	0.75	–1.8	2.5	–	–

Table 2. Results of determination of abundances [El/H].

El.	B–140	IY–25	I–13	III–63	III–73	103036	135148	Sun
O I	–4.26	–4.88	–4.61	–4.65	–4.67	–4.08	–4.58	–3.31
Mg I	–6.60	–6.59	–6.10	–6.45	–6.24	–5.84	–6.07	–4.49
Si I	–5.91	–5.49	–5.60	–	–5.69	–5.51	–5.67	–4.44
Ca I	–7.13	–7.00	–6.90	–6.90	–7.06	–6.88	–7.22	–5.68
Sc I	–10.62	–10.63	–10.63	–10.38	–10.24	–10.46	–10.29	–9.04
Ti I	–8.23	–8.46	–8.42	–8.20	–8.08	–8.19	–8.65	–7.17
V I	–9.60	–9.62	–9.58	–9.52	–9.42	–9.42	–9.95	–8.21
Cr I	–7.86	–8.18	–8.58	–8.12	–8.04	–7.33	–7.89	–6.25
Mn I	–8.15	–8.24	–8.11	–8.29	–8.29	–8.51	–8.97	–6.35
Fe I	–5.97	–5.66	–5.86	–5.71	–5.63	–5.84	–6.14	–4.40
Co I	–8.45	–8.68	–8.56	–8.60	–8.71	–8.00	–8.22	–7.25
Ni I	–7.26	–7.22	–7.39	–7.16	–7.35	–7.23	–7.78	–5.86
Cu I	–9.74	–9.86	–9.90	–9.93	–9.90	–9.83	–10.34	–7.35
Y II	–11.55	–10.51	–11.10	–	–10.66	–11.00	–	–9.88
Ba II	–11.90	–11.95	–11.22	–11.69	–11.60	–10.86	–11.51	–9.81
Ce II	–11.68	–11.63	–11.68	–11.26	–11.31	–12.11	–	–10.57
Nd II	–12.17	–12.16	–12.15	–12.11	–12.01	–11.68	–	–10.85

take interest, was investigated. For this Al excess has been obtained.

On the average O is slightly overabundant (0.1 dex) and Mg is underabundant (–0.5 dex) in the stars under study. Unfortunately, the results are obtained from one line only.

b) α–elements, Fe–peak, r–,s–processes. As is seen from the abundance curve, α–elements show excess, Co has no variations, Ni is slightly deficient(–0.08), Mn – more deficient. The Y element of s–process (primarily) is slightly overabundant. This elemental distribution is quite consistent with the fact that interstellar medium, from which the investigated stars originated, was enriched in products of Supernova II explosion synthesis.

c) Comparison with the halo stars has shown a difference in abundances of Na, Al, Mg and the elements of r–, s– processes.

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