SUBDWARFS: ABUNDANCE OF LIGHT ELEMENTS

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ABSTRACT. CNO abundances in the atmospheres of seven metal-deficient stars were derived by model atmosphere method on the basis of high dispersion Echelle spectra obtained using the 6-m telescope of the Special Observatory of the Russian Academy of Sciences. The O abundance are derived from lines of IR-triplet OI 7773 A. The $C_2(0,1)$ bandhead of the Swan $A^3\Pi_g$-$X^3\Pi_u$ system, at 5635.5 A is used to derive the C abundances. To derive the nitrogen abundances, the CN red system $A^2\Pi$-$X^2\Sigma$ was used, the CN(5,1) 6332.18 Å and 6478.48 Å were considered. The obtained [O/Fe] values confirm the trend of [O/Fe] vs [Fe/H]. For stars of our sample with [Fe/H] > -1.00 we found that nitrogen is overabundant relative to iron, carbon - underabundant.

Key words: stars:abundances - stars:atmospheres - stars:evolution

Introduction

The stars with large proper motions represent the old population of the Galaxy. Its atmospheres reflect the chemical composition of the interstellar medium at the time the stars formed and the study of element abundances in atmospheres of the unevolved stars permit to testify the process in early evolution of the Galaxy.

In this work we investigated CNO abundances in the atmospheres of metal-deficient stars (with large proper motions) by the synthetic spectral method from atomic and molecular spectral features.

Observations and atmosphere parameters

The program stars were selected from Laird et al. (1988) survey and (Carney et al., 1994). The observations have been carried out at the 6m telescope echelle spectrometer LYNX (Panchuk et al., 1993). equipped with a CCD of 530x580 pixels. The spectral resolution R = 25000, S/N ratio is more than 100 within the wavelength range 5200-8800 Å. Echelle spectra have been processed using the program of Galazutdinov (1992). Basic data and model atmosphere parameters are given in Table 1 (in detail, see Klochkova et al., 1995).

Table 1. The main data of the stars

Star	V	T_{eff}	log g	[Fe/H]	V_t
HD 64090	8.28	5370	3.0	-1.76	2.5
G29-20	9.17	5030	2.0	-0.91	1.2
G122-57	8.36	5040	3.0	-0.33	1.0
G182-7	8.10	5500	4.2	-0.14	2.0
G188-22	10.05	5860	3.5	-1.43	1.7
G246-38	9.91	5240	3.5	-2.00	3.5
G265- 1	8.37	5500	3.0	-0.65	1.5

Synthetic spectra for CNO abundance determination

CNO abundances are derived with the synthetic spectral method by the program STARSP (Tsymbal ,1994). The model atmospheres for each star are obtained by interpolations in the grids of model atmospheres by Bell et al (1976) and Kurucz (1979). Control of the parameter atmosphere choice was accomplished by the Fe I lines in the region of the spectral features using for this analysis. The accuracy of these abundance determination is 0.3 dex. The input list of atomic and molecular lines was compiled from (Kurucz 1993). Oscillator strengths $\log gf$ for atomic lines were taken from (Kurucz,1993). FMHM = 0.25 Å.

Oxygen. The O abundance are derived from lines of IR-triplet OI 7773 A. As find by King and Boesgaard (1995) for T_{eff} < 6200 K no systematic difference between the [O] 6300 Å and 7774 Å abundances for metal-poor giants or dwarfs.

Carbon. The $C_2(0,1)$ bandhead of the Swan $A^3\Pi_g$-$X^3\Pi_u$ system, at 5635.5 A is used to derive the C abundances. In the molecular line list of this feature were include the blend line of CN molecule but its influence become visible for temperatures lower 5000 K. $\log gf$ for C_2 lines were corrected according to (Shavrina and Kuznetsova 1996). A dissociation potential of $D(C_2)$ = 6.15 eV was used.

Nitrogen. To derive the nitrogen abundances, the CN red system $A^2\Pi$-$X^2\Sigma$ was used, the CN(5,1) 6332.18 Å and 6478.48 Å were considered. The dissociation potential adopted was $D(C_2)$ = 7.76 eV.

As for atomic carbon and nitrogen lines, the availa-

Table 2 Relative CNO abundances

Star	[C/Fe]	[N/Fe]	[O/Fe]
HD 64090	-	-	+0.39
G29-20	-0.10	+0.30	+0.35
G122-57	-0.20	+0.30	+0.15
G182-7	-0.16	+0.10	-0.36
G188-22	-	-	+0.50
G246-38	-	-	+0.80
G265- 1	0.00	+0.26:	+0.29

ble molecular bands are too week (not measurable) in metal-deficient stars in which [Fe/H] < -1.00 and T_{eff} > 5000 K. As shown our calculations, the bands are measurable at [Fe/H] < -1.00 on the temperatures lower 4500 K. C and N abundances have been obtained for stars with [Fe/H] > -1.00 .

The results are given in Table 2.

Discussion of results

Oxygen. According recently stellar evolution theory, oxygen is transformed into nitrogen in deep layers and is not mixed to the surface. Therefore, O abundance in case of unevolved and evolved stars reflects the matter from which stars formed. For all investigated stars have been obtained that O is overabundant relative to iron. Our values [O/Fe] confirm also the trend of [O/Fe]vs[Fe/H] shown by many authors (for example, Sneden et al. 1979; Barbuy 1983 etc) which testify that the halo was overenriched in oxygen with respect to iron at early times. Matteucci and François (1992) discuss the behavior of [O/Fe]vs[Fe/H] and a change in slope in the [O/Fe] ratio occurring at [Fe/H] = -1.7, as claimed recently by Bessel et al. 1991. They show that a change can be reproduced by a model where the star formation rate is almost linear with gas density and the iron production from massive stars is lower than previously assumed. A squared dependence of the star formation rate on the gas density will produce an almost constant [O/Fe] ratio between -3 and -1 in [Fe/H].

Carbon and nitrogen. The standard theory predicts that the matter enriched by CN-cycle products transferred to surface layers of stars and in evolved star atmosphere we must observe C underabundance and N overabundance. For stars of our sample with [Fe/H] > -1.00 we found that nitrogen is overabundant relative to iron, carbon - underabundant.

Acknowledgement. This work is partly supported by grant N 94-02-032181-a from the Russian Foundation of Fundamental Researches .

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