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NITROGEN-TO-CARBON RATIO IN 70 DWARF HALO STARS

D.F. Carbon[1], R.P. Kraft[2], B. Barbuy[3], E. Friel[2], N.B. Suntzeff[4]

Resumo: Observações de sub-anãs selecionadas a partir das listas de Sandage(1964, 1969, 1982) foram obtidas com o telescópio de 3 m do Lick Observatory, usando o receptor IDS. O tubo azul foi usado a fim de se obter as bandas de NH em λ3360 Å e de CH em λ4300 Å. Comparando-se espectros sintéticos às observações, as abundâncias de nitrogênio e carbono foram derivadas para as sub-anãs em questão.

Encontramos que a razão nitrogênio/carbono é constante com o tempo (ou metalicidade), indicando que o nitrogênio teria sido produzido como elemento primário na época de formação da Galáxia.

Abstract: A survey of subdwarf selected from the lists by Sandage(1964, 1969, 1982) was carried out with the 3 m telescope at Lick Observatory, using the image dissector scanner IDS as detector. The blue tube was used in order to obtain the NH band at λ3360 Å and the CH band at λ4300 Å. By comparing synthetic spectra with the observations, nitrogen and carbon abundances were derived for the sample of subdwarfs.

We found that the nitrogen-to-carbon ratio is constant in time (or with metallicity) showing that nitrogen was produces as a primary element at early times.

Keywords: population II, spectrum synthesis

1. Kitt Peak National Observatory, AZ, USA.
2. Lick Observatory, CA, USA.
3. Universidade de Sao Paulo, Brasil.
4. Mount Wilson and Las Campanas Observatory, CA, USA.

I. INTRODUCTION

Anomalies in population II stars are being detected in the last years thanks to modern instrumentation performances. High signal-to-noise data were obtained here in order to obtain the carbon and nitrogen abundances in old stars.

Nitrogen is produced from carbon and oxygen during hydrogen burning by the CNO cycle - the number of C + N + O atoms does not change in this process, and these elements only serve as catalysts in the transformation of hydrogen to helium. Consequently, the nitrogen (N) abundance depend on the initial stellar content of carbon (C) and oxygen (O), or in other words, on the metallicity. If N were a typical secondary element, it would behave like [N/C] = [C/H] (e.g. Arnett, 1971).

The low abundances of N in Gmb 1830 and ν Indi determined in the past (Tomkin and Bell, 1973; Harmer and Pagel, 1970) led to the inference that nitrogen is a purely secondary element. Since then, some papers have discussed this problem as Sneden (1974), Clegg (1977), Clegg et al.(1981), Bessell and Norris (1982), Barbuy (1983), Lambert and Tomkin (1984). In the present work we present a set of observations of a large sample of subdwarfs, and the data obtained give the behaviour of nitrogen-to-carbon ratio with metallicity, confirming the indications given in the more recent papers.

II. OBSERVATIONS

We observed 70 subdwarfs in the magnitude range V = 9.0 to 13.0 , with the image dissector scanner (IDS) detector and the 3m (Shane) telescope at Lick Observatory. The blue tube was used, covering the wavelength range $\lambda\lambda$ 3200 - 5000 Å at a resolution of 6 - 8 Å.

III. STELLAR PARAMETERS

Available photometry comprising (B-V) and $\delta(U-B)_{0.6}$ for all stars (Sandage 1964, 1969, 1982), supplemented by c_1, (b-y), (R-I), (V-K) photometry and Hδ, Γ(41-45), Γ(38-41) measurements on the spectra (see Friel et al., 1982) were used in order to derive effective temperatures T_{eff} and metallicity [M/H]. A further fit to atomic lines in the spectra served as a finer adjustment of the metallicity. Gravity was varied following van den Bergh (1983) from log g = 4.5 to 4.9. Microturbulent velocity v_t = 1.25 km s^{-1} was assumed for all stars of the sample.

IV SPECTRUM SYNTHESIS

Calculations were all carried out by D. F. Carbon using the CYBER at Kitt Peak National Observatory. Wavelength regions of $\Delta\lambda \simeq 300$ Å were considered, i.e., $\lambda\lambda$ 3320. - 3634 Å around the NH band and $\lambda\lambda$ 4230. - 4543 Å around the G-band. The code is described in detail by Carbon et al. (1982).

V RESULTS AND DISCUSSION

The results are presented in figure 1, where [N/C] versus [C/H] is given (the names of some stars showing extreme behaviours are indicated in the figure).

It can be seen that the nitrogen-to-carbon ratio does not decrease with decreasing metallicity, which would be the behaviour expected for a purely secondary element.

The fact that [(C+N)/Fe] ratio is about the same for subdwarfs and giants (Langer and Kraft, 1984) would indicate that a constant [N/Fe] ratio would also be found in giants if mixing effects were eliminated.

We can conclude that nitrogen is produced as a secondary plus a primary component at all times, and especially at early times.

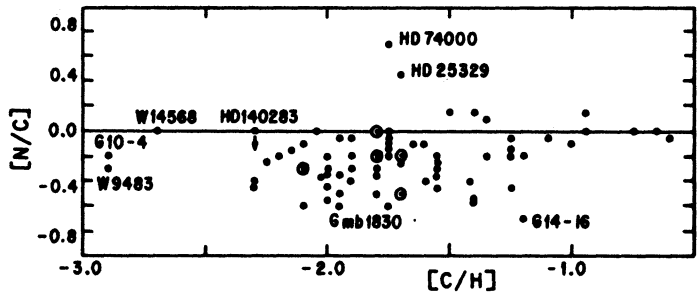

Figure 1 - Plot of nitrogen-to-carbon versus carbon-to-hydrogen ratios

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B. Barbuy: Universidade de São Paulo, Instituto Astronômico e Geofísico, C.P. 30627, São Paulo 01051 SP, Brasil.

D.F. Carbon: Kitt Peak National Observatory, P.O. Box 26732, Tucson, AZ. 85726 USA.

E. Friel and R.P. Kraft: Lick Observatory, University of California at Santa Cruz, Santa Cruz, CA.95064 USA.

N.B. Suntzeff: Mount Wilson and Las Campanas Observatory, 813 Santa Barbara St., Pasadena CA. 91101 USA.