THE IRON ABUNDANCES, [FE/H] IN THE FOUR NEAREST OPEN CLUSTERS : PLEIADES, URSA MAJOR STREAM, COMA BERENICES AND HYADES

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ABSTRACT. Iron abundances, [Fe/H] have been studied in G and K dwarfs of the four nearest clusters. With the exception of the Pleiades stars which are all fainter than the 10th magnitude, the observational material consists of high resolution, high S/N spectra taken at the coudé Reticon spectrograph of the Canada, France Hawaii Telescope. The Hyades is the only cluster with a significative overmetallicity with respect to the Sun.

1. INTRODUCTION

The variation of metallicity as a function of space and time is a central problem in the knowledge of the chemical evolution of our Galaxy and of other galaxies. We are studying this problem using the stellar content of the solar neighborhood in which objects of all ages can be found. We know that our nearest neighbours, the field stars are chiefly old disk population stars, sometime quite older than the Sun. Their metallicities vary from factors by 1 to 3, more, to factors by 1 to 5, less, than that of the Sun. If we want to study the metallicities of young disk population stars we have to turn towards stars belonging to nearby open clusters. Indeed, in the understanding of the chemical composition of our Galaxy the nearby open clusters play an important role. Cluster members are often used as reference stars for photometric and/or low resolution spectroscopic abundance techniques. Their abundances have to be reliably determined, if we want to use these stars as milestones for the study of the chemical evolution of a galaxy.
Here, we present an analysis of the determination of iron abundance in some G and K stars belonging to the Pleiades, Ursa Major stream, Coma Berenices and Hyades. We have already published iron and metal abundances of 12 G and K dwarfs of the Hyades (Cayrel et al. 1985). The same reduction procedure and spectral detailed analysis as in this research have been used in studying the stars of the other three clusters.

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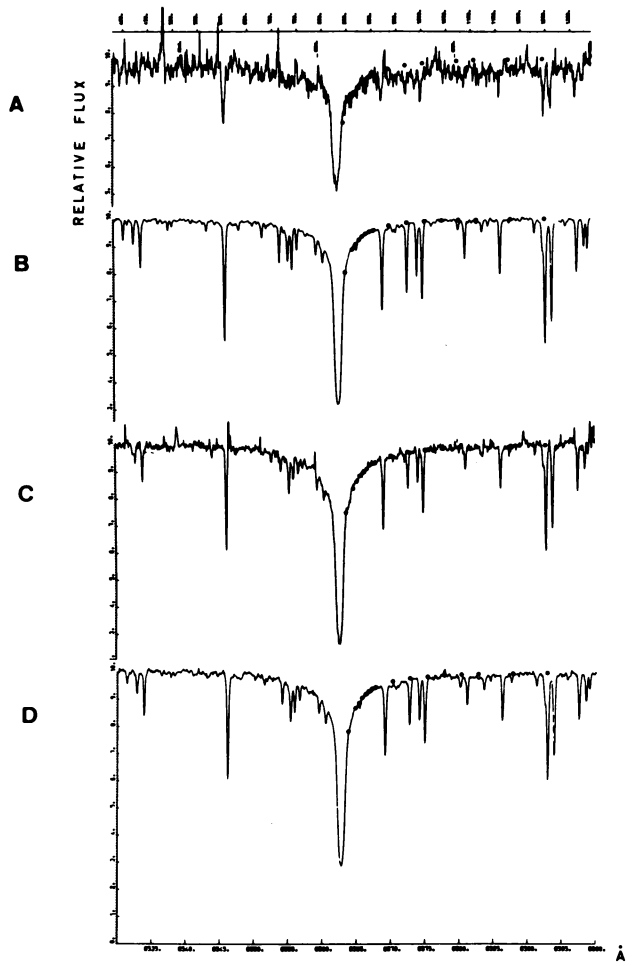

Fig. 1. CFH Reticon spectra of the Hα region of:
A HII 1776, G5V, in the Pleiades,
B HD 41593, K0V, in UMa,
C TR 132, G5V, in Coma,
D VB 92, G8V, in the Hyades,
dots represent the best fitting computed profiles.

2. OBSERVATIONS, DATA REDUCTIONS, AND DETAILED SPECTRAL ANALYSES OF THE CLUSTER STARS.

All the stars contained in Table 1 have been observed with the CFH

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Telescope using the Coudé spectrograph and a cooled Reticon array of 1872 pixels. In this table are also included five specimen of the twelve Hyades stars previously analyzed. (Cayrel et al. 1985). As we can see from Table 1, the signal/noise ratio of the Pleiades stars (all fainter than the 10th magnitude) is much smaller than that of the stars of the other clusters. The most nasty feature, during long exposures, is the large number of cosmic ray spikes which damage the spectrum. Special attention has been payed in the reduction of the equivalent widths of the stars of the Pleiades.

Table 1

Some basic parameters for the stars of the four clusters

PLEIADES

Age ~ 80 10^6 yrs
Distance ~ 135 pc

Star	S/N	V	Sp	T_{eff}K	[Fe/H]
HII 1101	110	10.26	F9V	6100	+0.09±0.12
1776	44	10.91	G5V	5600	+0.02±0.19
2462	44	11.55	-	5300	+0.16±0.12
296	38	11.46	G8V	5100	+0.26±0.17

COMA BERENICES

Age ~ 500 10^6 yrs
Distance ~ 85 pc

Star	S/N	V	Sp	T_{eff}K	[Fe/H]
TR 162	150	8.61	G0V	6250	-0.07±0.14
85	150	9.33	G1V	5850	-0.06±0.09
132	140	9.91	G5V	5700	+0.02±0.11
213	90	10.51	K0V	5300	0.00±0.14

URSA MAJOR

Age ~ 160 10^6 yrs
Distance from ~ 8 to ~ 20 pc

Star	S/N	V	Sp	T_{eff}K	[Fe/H]
γLepA	700	3.60	F6V	6200	-0.14±0.04
γLepB	400	6.15	K2V	4950	+0.02±0.06
π'UMa	500	5.64	G0V	5850	-0.01±0.06
HD115043	370	6.85	G1V	5830	-0.03±0.04
HD41593	600	7.23	K0V	5350	+0.08±0.04

HYADES

Age ~ 650 10^6 yrs
Distance ~ 44 pc

Star	S/N	V	Sp	T_{eff}K	[Fe/H]
VB 73	300	7.85	G1V	5900	+0.143±.035
52	440	7.80	G1V	5840	+0.028±.035
64	200	8.12	G2V	5770	+0.138±.035
92	300	8.66	G8V	5540	+0.157±.050
46	200	9.11	K1V	5170	+0.070±.100

The effective temperatures have been determined from the wings of the Hα lines (Fig. 1). The iron abundance of each star has been obtained by comparing the observed equivalent widths of iron lines with those of appropriate models interpolated in a grid of model atmospheres (Gustafsson 1981). The results from the detailed spectral analyses are contained in Table 1.

3. DISCUSSION OF THE RESULTS.

The list of dwarfs analyzed in each cluster is presented in Table 1. In this table the clusters do rank in order of increasing cluster age. The mean metallicities of the first three clusters does not seem to deviate from the solar one. Among the stars of a same cluster slight difference in [Fe/H] are found. The authors of this paper have considered this problem and have proposed that such differences may be caused by stellar

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activity (Cayrel et al. 1985). The Hyades are the only cluster with a significative overmetallicity with respect to the Sun.

4. CONCLUSION

We have studied the iron abundances, [Fe/H] in G and K dwarfs of the four nearest clusters. The observational material was excellent except for the stars of the Pleiades. Significant differences in the [Fe/H] values have been found between the stars of a single cluster in the Hyades, Ursa Major and Pleiades. The Hyades are the only cluster showing a significative enhancement in [Fe/H] with respect to the Sun, confirming that determined from Strömgren's photometry.

REFERENCES.

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Gustafsson, B.: 1981 (private communication).

DISCUSSION

BASRI How worried are you by the effects of chromospheric activity on the wings of Hα used to make T_{eff} determinations, especially for very active stars.

R. CAYREL For stars not more active than the Hyades we are confident that keeping away of the (−2 Å, +2 Å) region around the center of Hα our T_{eff} is not contaminated by activity. For the Pleiades the activity is so strong that we do not believe that Hα is still a reliable T_{eff} indicator.

BESSELL Comment: It is always advantageous to use continuum colors or fluxes such as R−I, V−K and IR flux method, for effective temperature derivation in addition to hydrogen line profiles.

DUNCAN Comment: Paul Butter, Geoff Marcy, Ross Cohen, and I have completed a study of 4 rapidly rotating and 4 slowly rotating K dwarfs in the Pleiades [Ap.J. LeH., in press]. We find that all of the rapid rotators, usually thought to be older, have much more Li than the slow rotators. HII 296 may show a similar effect.

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