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α-elements in mildly metal-poor stars

H. Decauwer[1], E. Jehin[2], G. Parmentier[3], and P. Magain[1]

[1]AGO (B5c), University of Liège, B-4000 Liège, Belgium – email: hdecauwer@ulg.ac.be
[2]ESO, Casilla 19001, Alonso de Cordova 3107, Vitacura, Santiago, Chile
[3]Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK

Abstract. Accurate relative abundances of light elements (C to Ca) have been obtained in a sample of mildly metal-poor stars (Decauwer *et al.* 2005). Combined with the results of a previous study (Jehin *et al.* 1999), we find different slopes in the correlations between the different α-elements. These results can be explained by postulating that the stars exhibiting lower than average α/Fe form in low mass clouds, unable to sustain the formation of very massive stars.

Keywords. Stars: abundances, Galaxy: evolution

1. Introduction

In a previous study (Jehin *et al.* 1999), we had obtained precise relative abundances for a sample of 21 mildly metal-poor stars ([Fe/H] ~ -1), whose metallicities are characteristic of the disk-halo transition. The main emphasis was on the study of the neutron-capture elements, both from the s- and the r-processes.

In the present study (based on observations collected at the European Southern Observatory, La Silla, Chile), lighter elements (i.e., C, O, Si, Ca, Na and Al) are analyzed.

The abundances are determined using the same model atmospheres as Jehin *et al.* , so that our results are directly comparable to theirs.

2. α-element abundances

The abundances of the α-elements are nicely correlated. However, the slopes of the best fit lines in these diagrams differ significantly from unity. The two lightest α-elements, O and Mg, show the same behaviour, with a slope > 1 when compared to Ti, i.e. a range of variation which is significantly larger than the one of Ti. On the contrary, the two heavier α-elements, Si and Ca, which also behave in the same way, present a slope < 1, and thus show less variation than Ti (and, of course, than O and Mg).

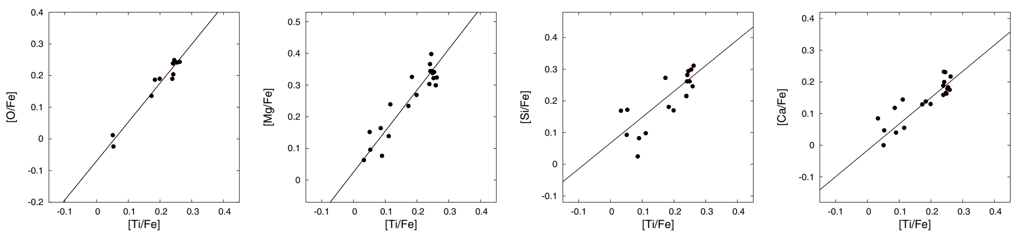

Figure 1. Abundances of O, Mg, Si and Ca relative to Fe versus [Ti/Fe]. Solid lines represent the fits.

If one accepts the idea that these α-elements have been mostly synthesized in massive (i.e., $M > 8M_{\odot}$) stars, the different slopes exhibited by the light and heavy α-elements

Abundance ratios	slope
[O/Fe] vs. [Ti/Fe]	1.21 ± 0.14
[Mg/Fe] vs. [Ti/Fe]	1.21 ± 0.10
[Si/Fe] vs. [Ti/Fe]	0.76 ± 0.06
[Ca/Fe] vs. [Ti/Fe]	0.81 ± 0.05

Table 1. Slopes of the regression lines for the α-elements.

suggest that the yields of the lighter α-elements O and Mg present a variation with the star mass larger than the yields of the heavier ones Si and Ca.

3. A cloud mass dependent scenario

We assume that these metal-poor stars form in gas clouds presenting a large mass range, with some clouds of mass much lower than the progenitors of the present day globular clusters.

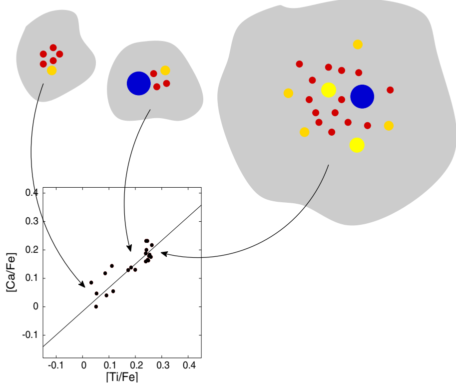

Figure 2. Schematic view of the scenario.

The massive clouds are able to form first generation stars covering the whole mass range, up to the highest masses. When first generation supernovæ (SNe) explode, they trigger the formation of a second generation of stars in a supershell. These second generation stars are enriched (e.g. in α-elements) by the SN ejecta. As the most massive SN progenitors produce larger amounts of light α-elements (O, Mg), these second generation stars exhibit maximum values of α/Fe, O/Si, Mg/Ca, ...

Even with a constant Initial Mass Function, the low mass clouds have a lower probability of forming very massive stars. Some of these clouds will thus lack them. As a result, the second generation stars will be less enriched in lighter α-elements.

The combination of stars originating from clouds of different masses will produce a scatter in α/Fe, O/Si, Mg/Ca, ... as well as the observed correlations.

Acknowledgements

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