ABUNDANCE ANOMALIES IN RGB STARS: FIELD VS GCS

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In globular clusters (GCs), some abundance patterns for C, O, Na, Mg, Al and some α-elements are observed at the surface of red giants (RGB), which are not expected from standard stellar evolution. These 'abundance anomalies' may result from primordial pollution of the intracluster gas and/or evolutionary effects due to some extra mixing process inside RGB stars. In order to disentangle between both scenarii and to investigate the importance of the environment, we analyse a set of abundance data for both field and globular cluster stars over a wide range of metallicity and evolutionary status.

Our main sample is made up of data for field and globular cluster stars collected in the literature and for which abundances of O, Na, Mg, Al and Ba (when available) have been rederived from LTE analysis by Thévenin (1998). In order to complete the low metallicity part of the field stars sample we have also used additional data from Gratton et al. (2000)* and Pilachowski et al. (1996). For those field stars whose Hipparcos parallaxes are known, we derive the masses and evolutionary status using the Geneva evolutionary tracks.

Thévenin's sample contains 93 stars from 21 GCs. In order to have a better statistic we complete this sample with all relevant GCs data we could find in the literature. This is legitimated by the fact that for a given object, the differences in the abundances do not vary by more than 0.2 dex from an author to another, which is the typical error given by Thévenin. The resulting sample still lacks data points on the lower part of the RGB. Only few stars have been observed at the turn-off in metal-poor clusters (Gratton et al., 2001 and Thévenin et al., 2001) (see Figure 1).

Plotting the abundances against luminosity reveals no evolutionary effect neither for field nor for globular cluster stars (see Figure 1). The overall abundances present a larger dispersion in globular cluster red giants (GCRGs) than in field giants, whatever the magnitude considered. For those GCs where we have observations at the turn-off, the dispersion (large or low) seems to hold along the giant branch.

The effect of a possible additional transport process inside RGB stars might only affect carbon, and not the heavier elements we have focused on, or be hidden by primordial patterns. The large dispersion at given luminosity and metallicity in GCRGs as well as in field stars underlines the importance of the environment.

* Gratton's abundances result from non-LTE analysis, it has been shown that [el/Fe] are only weakly affected by departures from LTE.

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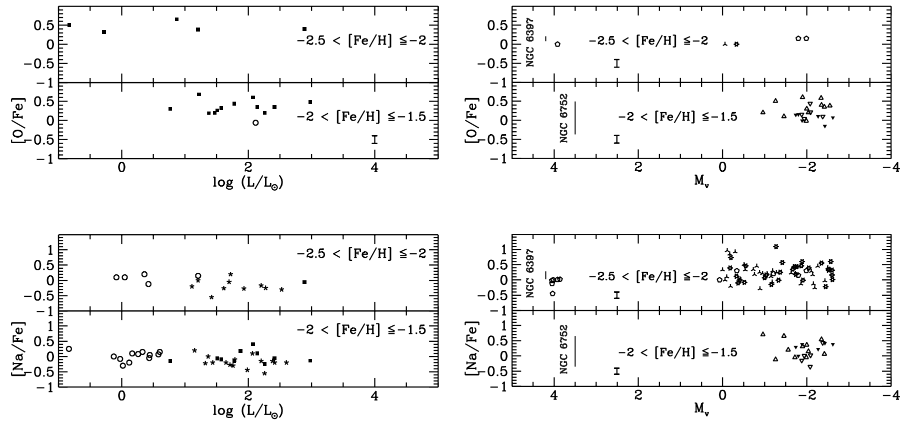

Figure 1. O and Na as a function of luminosity for -2.5 ≤ [Fe/H] ≤ −1.5, for field stars (left panels) and GCRGs (right panels, where the vertical lines show the range of abundances observed at the turn-off in NGC6752 and NGC6397 by Gratton et al.)

This is confirmed by the Ba data that appear to be very different in otherwise similar clusters such as M4 and M5. Indeed, this element is likely to be produced in intermediate-mass or massive stars, and could therefore be a tracer of primordial pollution.

At the moment, we have too few data points at our disposal to reach definitive conclusions on the abundances evolution as a function of luminosity along the RGB. This is yet one of the best ways to understand the origin of the abundance anomalies, and we therefore emphasize the need for observations of the lower part of the RGB in GCs and on the main sequence.

References

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