APOGEE Chemical Anomalies discovered everywhere in the Milky Way: Giant stars with GC-like abundance patterns

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Abstract. We report the discovery by APOGEE of five mildly metal-poor ([Fe/H] > −1) anomalous giant stars in the halo/disk/bulge Galaxy with abundances of C, N, and Al that are typically found in globular cluster stars (GCs, see e.g. Carretta et al. 2009a; Mészáros et al. 2015; Pancino et al. 2017; Schiavon et al. 2017a; Tang et al. 2017) and in the inner Galaxy (e.g., Schiavon et al. 2017b; Recio-Blanco et al. 2017) simultaneously with atypical abundances of Mg (Mg-poor: [Mg/Fe] < 0) never before seen in Milky Way (MW) GCs, dwarf galaxies (see Hasselquist et al. 2017) neither in MW field stars. Additionally, four new moderately metal-poor ([Fe/H] < −1) anomalous giant stars (i.e., N-rich, Al-rich and C-poor) with trustly GCs second-generation like chemical patterns were identified within the Galactic bulge, halo and disk field.

Keywords. Galaxy: structure – stars: abundances – stars: Population II – globular clusters: general

1. Relevant results

A number of independent studies from many different surveys argue that all Galactic GCs lost mass through the escape of individual stars (Schaerer & Charbonnel 2011; Anguiano et al. 2016; Fernández-Trincado et al. 2013, 2015a, 2015b, 2016a, 2016b; and references therein). The high-resolution (R ~ 22,500) H-band spectra (Albareti et al. 2017) provided by the APOGEE instrument (see Wilson et al. in prep) and its ability to produce accurate stellar abundances can be used to identify the escaped members of GCs. We have made a detailed spectrum synthesis analysis of ~ 4,000 sources, which has led to the discovery of anomalous field giant stars possibly born in GCs. Such is the case of TYC 5619-109-1, which is heavily enriched in light-elements (Al and N) and also enhanced in the s-process elements (Nd, Ce, Ba, La: Hasselquist et al. 2016; Pereira et al. 2017; Cunha et al. 2017), both chemical and orbital arguments render it plausible that TYC 5619-109-1 born in the anomalous GC ω Cen (see Fernández-Trincado et al. 2016a; Pereira et al. 2017). More recently, a new group of moderately metal-poor stars ([Fe/H] < -1) with enhanced N and Al abundances were recently discovery by Fernández-Trincado et al. (2017) along the disk, bulge and halo – in other words, the newly discovered stars present the same levels of enrichment in light elements as that of second generation stars in metal-poor GCs. However, in the same study, Fernández-Trincado et al. (2017) claimed to have discovered for the first time a new group of mildly metal-poor stars ([Fe/H] > −1), with high levels of enrichment in light elements (N-rich and Al-rich stars), and low values of [Mg/Fe]. The detection is clearly illustrated in Fig. 1 where each of these Mg-poor stars are plotted against MW stars with similar metallicities. Such values of 14N and 27Al enhancements and 24Mg depletions have never been seen in MW GCs.
Figure 1. The distribution of the Mg-poor/N-rich stars (orange symbols) from Fernández-Trincado et al. (2017) in the [Al/Fe]-[Mg/Fe] plane (left panel) and [Mg/Fe]-[Fe/H] plane (right panel). The logarithmic contours show the number density of the APOGEE DR 13 metal-poor stars (−1.8 < [Fe/H] < −0.7) surviving the quality cuts discussed in Fernández-Trincado et al. (2017). The black dotted line mark the Solar abundance ratio.

environments at the same metallicity (see Mészarós et al. 2015; Pancino et al. 2017). The complex chemistry and orbital properties of these MW Mg-poor stars suggest that these may be of an extragalactic origin (see Mucciarelli et al. 2012). This discovery opens a new route of investigation into nucleosynthesis and stellar evolution of chemically anomalous stars and brings very interesting constraints on the subject of Multiple Stellar Populations in GCs.

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References