HIGH-RESOLUTION ABUNDANCE ANALYSIS OF VERY METAL-POOR R-I STARS

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The moderately r-process enriched stars (r-I; +0.3 ≤ [Eu/Fe] ≤ +1.0) are, at least, four times as common as those that are greatly enriched in r-process elements (r-II; [Eu/Fe] > +1.0), and the abundances in their atmospheres are important tools for obtaining better understanding of the nucleosynthesis processes responsible for the origin of the elements beyond the iron peak. In this contribution, we derived abundances for a sample of 7 metal-poor stars with -3.4 ≤ [Fe/H] ≤ -2.4 classified as r-I stars, in order to understand the role of such stars for constraining the astrophysical nucleosynthesis event(s) responsible for the production of the r-process, and to investigate whether they differ, in any significant way, from the r-II stars. Based on high-resolution spectra obtained with the VLT/UVES spectrograph, we have obtained abundances of the light elements Li, C and N, the alpha-elements Mg, Si, S, Ca and Ti, the odd-Z elements Al, K, and Sc, the iron-peak elements V, Cr, Mn, Fe, Co, and Ni, and the trans-iron elements from the first peak (Sr, Y, Zr, Mo, Ru, and Pd), the second peak (Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, and Yb), the third peak (Os and Ir, as upper limits), and the actinides (Th) regions. The results are compared with values for these elements for r-II and "normal" very and extremely metal-poor stars reported in the literature, ages based on radioactive chronometry are explored using different models, and a number of conclusions about the r-process and the r-I stars are presented. Hydrodynamical models were used for some elements and general behaviors for the 3D corrections were presented. Although the abundance ratios of the second r-process peak elements (usually associated with the main r-process) appear nearly identical for r-I and r-II stars, the first r-process peak abundance ratios (probably associated with the weak r-process) appear enhanced in r-I stars compared with r-II stars, suggesting that differing nucleosynthesis pathways were followed by stars belonging to these two different classifications.