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Neutron-capture elements in halo, thick-disk, and thin-disk stars. Strontium, yttrium, zirconium, cerium

Mashonkina L., Vinogradova A., Ptitsyn D., Khokhlova V., Chernetsova T.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We derived Sr, Y, Zr, and Ce abundances for a sample of 74 cool dwarfs and subgiants with iron abundances, [Fe/H], between 0.25 and -2.43. These estimates were obtained using synthetic spectra, assuming local thermodynamic equilibrium (LTE) for Y, Zr, and Ce, allowing for non-LTE conditions for Sr. We used high-resolution ($\lambda/\Delta\lambda \approx 40\,000$ and 60 000) spectra with signal-t--noise ratios between 50 and 200. We find that the Zr/Y, Sr/Y, and Sr/Zr ratios for the halo stars are the same in a wide metallicity range ($-2.43 \le$ [Fe/H] ≤ -0.90), within the errors, indicating a common origin for these elements at the epoch of halo formation. The Zr/Y ratios for thick-disk stars quickly decrease with increasing Ba abundance, indicating a lower rate of production of Zr compared to Y during active thick-disk formation. The thick-disk and halo stars display an increase in the [Zr/Ba] ratio with decreasing Ba abundance and a correlation of the Zr and Eu overabundances relative to Ba. The evolutionary behavior of the abundance ratios found for the thick-disk and halo stars does not agree with current models for the Galaxy's chemical evolution. The abundance ratios of Y and Zr to Fe and Ba for thin-disk stars, as well as the abundance ratios within each group, are, on average, solar, though we note a slight decrease of Zr/Ba and Zr/Y with increasing Ba abundance. These results provide evidence for a dominance of asymptotic-giant-branch stars in the enrichment of the interstellar medium in heavy elements during the thin-disk epoch, in agreement with the predictions of the nucleosynthesis theory for the main s-process component. © 2007 Pleiades Publishing, Ltd.

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