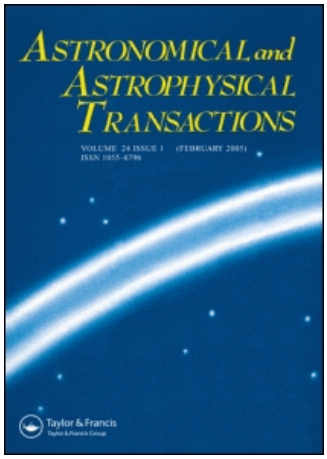


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# Magnesium abundance in the galactic thin-disc stars and subsystem formation history

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# Magnesium abundance in the galactic thin-disc stars and subsystem formation history

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Data from our compiled catalogue of spectroscopically determined magnesium abundances in stars with accurate parallaxes are used to select thin-disc and thick-disc dwarfs and subgiants according to kinematic criteria. We analyse the relations between the relative magnesium abundances [Mg/Fe] in thin-disc stars and their metallicities, Galactic orbital elements and ages.

*Keywords*: Galaxy (Milky Way); Stellar chemical composition; Thin disc; Galactic evolution

In figure 1, we can see that the [Mg/Fe] ratios in the thin disc at any metallicity in the range $-1.0\,\mathrm{dex} < [\mathrm{Fe/H}] < -0.4\,\mathrm{dex}$ to be smaller than those in the thick disc, implying that the thin-disc stars are on average younger than the thick-disc stars.

The relative magnesium abundances in such metal-poor thin-disc stars have been found to decrease systematically with increasing stellar orbital radii in such a way that magnesium overabundances ($[\mathrm{Mg/Fe}] > 0.2\,\mathrm{dex}$) are essentially observed only in the stars whose orbits lie almost entirely within the solar circle. At the same time, the range of metallicities in magnesium-poor stars is displaced from $-0.5\,\mathrm{dex} < [\mathrm{Fe/H}] < 0.3\,\mathrm{dex}$ to $-0.7\,\mathrm{dex} < [\mathrm{Fe/H}] < 0.2\,\mathrm{dex}$ as their orbital radii increase. This behaviour suggests that, firstly, the star formation rate decreases with increasing Galactocentric distance and, secondly, there was no star formation for some time outside the solar circle while this process was continuous within the solar circle. This follows from the presence of a distinct jump in the [Mg/Fe] ratio at metallicities $[\mathrm{Fe/H}] < -0.4\,\mathrm{dex}$ for stars with large orbital radii. The larger [Mg/Fe] ratios at high metallicities in the stars within the solar circle suggest that the star formation rate remains even higher there at present. The clear deficit of stars with metallicities higher than the solar value there is also indicative of a lower star formation rate at great Galactocentric distances.

The decrease in the star formation rate with increasing Galactocentric distance is responsible for the existence of a negative radial metallicity gradient ($\mathrm{grad}_R\,[\mathrm{Fe/H}] = (-0.05 \pm 0.01)\,\mathrm{kpc}^{-1}$) in the disc, which shows a tendency to increase with decreasing age. At

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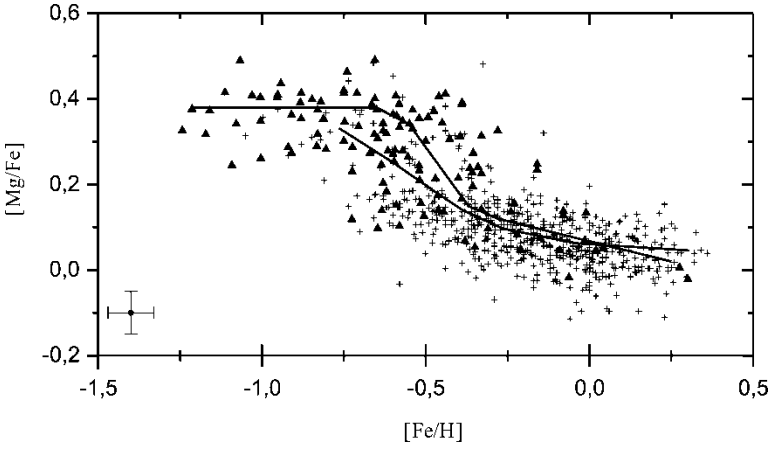


Figure 1. The metallicity versus the relative magnesium abundance for the stars of both disc subsystems: crosses, thin-disc stars; full triangles, thick-disc stars; broken curves, median lines of the relations for the thin and thick discs drawn by eye halfway between corresponding the upper and lower envelopes.

the same time the relative magnesium abundance exhibits no radial gradient. We have confirmed the existence of a steep negative vertical metallicity gradient ($\mathrm{grad}_Z$ [Fe/H] = $(-0.29 \pm 0.06)$ kpc$^{-1}$) and detected a significant positive vertical gradient in relative magnesium abundance ($\mathrm{grad}_Z$ [Mg/Fe] = $(0.13 \pm 0.02)$ kpc$^{-1}$); both gradients increase appreciably in absolute value with decreasing age. The existence of non-zero vertical gradients in both metallicity and relative magnesium abundance far beyond the error limits in the thin disc

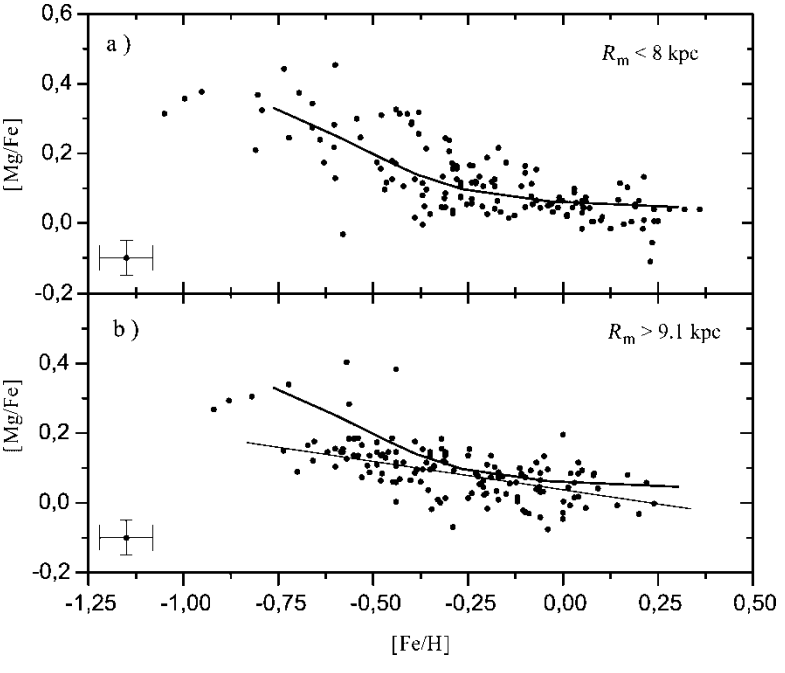


Figure 2. The metallicity versus the relative magnesium abundance for the thin-disc stars in two ranges in the mean orbital radii, $R_m < 8$ kpc and $R_m > 9$ kpc: thick solid curves, median lines for the thin disc; thin line in (b), straight regression for stars with [Mg/Fe] $< 0.2$ dex.

probably suggests that the fall of a metal-poor gas to the disc, the star formation and the contraction of the interstellar medium in the forming subsystem are simultaneous processes.

We have found that there is not only an age–metallicity relation but also an age–magnesium abundance relation in the thin disc. We surmise that the thin disc has a multicomponent structure but the existence of a negative trend in the star formation rate along the Galactocentric radius does not allow the stars of its various components to be identified in the immediate solar neighbourhood.

A full description of the investigation was published in [1].

## Reference

[1] V.A. Marsakov and T.V. Borkova, Astron. Lett. **32** 376 (2006).