Chemical abundance patterns in the inner Galaxy: the Scutum Red Supergiant Clusters

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The location of the Scutum Red-Supergiant (RSG) clusters at the end of the Galactic Bar makes them an excellent probe of the Galaxy's secular evolution; while the clusters themselves are ideal testbeds in which to study the predictions of stellar evolutionary theory. To this end, we present a study of the RSGs' surface abundances using a combination of high-resolution Keck/NIRSPEC H-band spectroscopy and spectral synthesis analysis. We provide abundance measurements for elements C, O, Si, Mg, Ti, and Fe. We find that the surface abundances of the stars studied are consistent with CNO burning and deep, rotationally enhanced mixing. The average $alpha$/Fe ratios of the clusters are solar, consistent with a thin-disk population. However, we find significantly sub-solar Fe/H ratios for each cluster, a result which strongly contradicts a simple extrapolation of the Galactic metallicity gradient to lower Galacto-centric distances. We suggest that a simple one-dimensional parameterization of the Galaxy's abundance patterns is insufficient at low Galactocentric distances, as large azimuthal variations may be present. Indeed, we show that the abundances of O, Si and Mg are consistent with independent measurements of objects in similar locations in the Galaxy. In combining our results with other data in the literature, we present evidence for large-scale (simkpc) azimuthal variations in abundances at Galacto-centric distances of 3-5,kpc. While we cannot rule-out that this observed behaviour is due to systematic offsets between different measurement techniques, we do find evidence for similar behaviour in a study of the barred-spiral galaxy NGC~4736 which uses homogeneous methodology. We suggest that these azimuthal abundance variations could result from the intense but patchy star formation driven by the potential of the central bar.

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