From Lithium to Uranium: Elemental Tracers of Early Cosmic Evolution
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Oxygen abundances in the galactic bulge

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Abstract. We present preliminary oxygen abundances in a sample of four red-giants belonging to the bulge population. The abundances were derived from OH molecular transitions in the infra-red high-resolution spectra obtained with the Phoenix spectrograph on Gemini South. The target stars were taken from the previous study by McWilliam & Rich (1994) and selected in order to span a range in [Fe/H] from −1.0 to +0.5. Our oxygen results are found to be enhanced and fall above the Milky Way disk trend; in agreement with the high abundances obtained previously for other $\alpha - elements$. It is important to note, however, that the enhanced OH abundances obtained here are based upon stellar parameters taken directly from McWilliam & Rich (1994). Significant revisions to these published values are found more recently in McWilliam & Rich(2003) Such revisions would result in derived oxygen abundances that are systematically lower and perhaps in better agreement with the Milky Way trend. The conclusion is that further efforts are needed in order to better define the stellar parameters for the target stars, as they are crucial in order to decide the important issue of whether the oxygen abundances are enhanced in the bulge K-giants, as we find here. Or, on the other hand, if they follow the trend defined for the Milky Way disk.

Keywords. Stars: abundances, Galaxy: bulge

1. Introduction

Chemical abundances for the different stellar populations in the Milky Way are important constraints to models of Galaxy formation and chemical evolution. The bulge constitutes one galactic component that has not been extensively studied, especially from spectroscopic observations at high-resolution. In general terms, from studies conducted to date, it is found that the bulge metallicity peaks at [Fe/H] $\simeq -0.3$ dex, encompassing a broad metallicity range and with a tail that extends to low abundances.

The first high-resolution optical study of bulge K-giants by McWilliam & Rich (1994) found enhancements in the alpha-element abundances, with some decline as [Fe/H] increased. This study did not, however, analyze the key element oxygen. More recently, Rich & Origlia (2005) found from infra-red spectra of bulge M giants that the α-element to iron abundance ratios are enhanced by an average value around +0.3 dex relative to solar composition. Their target stars probed metallicities between roughly [Fe/H]= −0.3 and slightly below solar, therefore, not extending to the higher metallicities of +0.5 dex sampled for the K-giants. Fulbright *et al.* (2004) derived oxygen abundance in their sample of bulge K-giants and found that [O/Fe] seems to decrease (perhaps even more sharply than the Milky Way trend), indicating virtually no SN II production at bulge high metallicities. Note, however, that the latter differs from the Mg abundances that are found to be enhanced in [Mg/Fe]. Our goal here is to derive oxygen abundances from infrared OH lines for stars in their sample spanning a range in [Fe/H].

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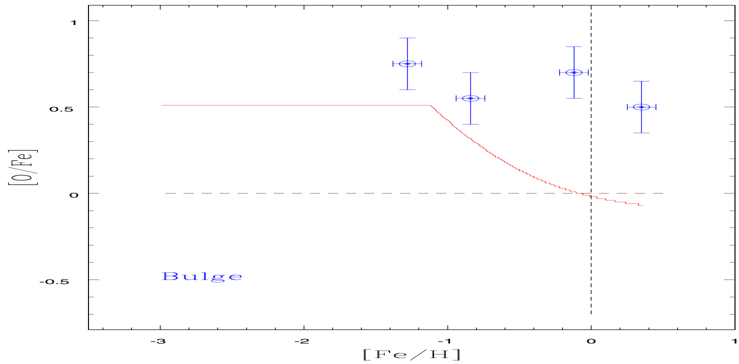

Figure 1. Preliminary results for [O/Fe] versus [Fe/H] for the target K-giants. The oxygen abundances were obtained from OH and by adopting the stellar parameters from McWilliam & Rich (1994). The Milky Way disk and halo trend is illustrated by the solid line.

2. Observations and Analysis

The target stars are K giants in the direction of Baade's window and were drawn from the McWilliam & Rich (1994) study. High-resolution infrared spectra around the H and K bands were obtained with the Phoenix spectrograph on the Gemini South telescope. Stellar parameters and metallicities [Fe/H] were taken from the study by McWilliam & Rich (1994).

3. Discussion

Our oxygen abundance results are shown in Figure 1 as open circles. The behavior of [O/Fe] versus [Fe/H] obtained for the Milky Way halo plus disk is roughly illustrated by the solid line. This shows enhanced oxygen abundances for halo metallicities and a decline in [O/Fe] as [Fe/H] increases, due to delayed Fe production in SN Ia. Our bulge abundances clearly fall above this trend. These oxygen results are in agreement with the alpha-enhancements found by McWilliam & Rich (1994), in particular for Mg. A discrepancy between the results for oxygen and magnesium, both produced in SN II, are not easily explained and alternative scenarios are needed.

It is important to point out, however, that the OH molecule is very sensitive to the effective temperature at the temperatures of the studied stars. Significant revisions to the stellar parameters adopted for the target stars have been presented by McWilliam & Rich (2003). These new parameters and their subsequent impact on the derived oxygen abundances from OH lines need to be carefully investigated in the future. In particular, in this more recent investigation, they find effective temperatures that are significantly lower (in one case by 385 K). Abundance corrections due to decreasing the effective temperature would then result in oxygen abundances (from OH) that are lower and would then be in better agreement with the trend observed for the Milky Way disk.

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