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A very low upper limit for a Be abundance of a carbon-enhanced metal-poor star

Hiroko Ito[1,2], Wako Aoki[1,2], Satoshi Honda[3], Timothy C. Beers[4], and Nozomu Tominaga[5]

[1]Department of Astronomical Science, School of Physical Sciences, The Graduate University for Advanced Studies (SOKENDAI), 2-21-1, Osawa, Mitaka, Tokyo, 181-8588, Japan
email: `hiroko.ito@nao.ac.jp`

[2]National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan
[3]Gumma Astronomical Observatory, Agatsuma, Gunma, Japan
[4]Michigan State University, East Lansing, MI 48824-1116, USA
[5]Konan University, Kobe, Hyogo, Japan

Abstract. We performed a 1D LTE chemical abundance analysis of an extremely metal-poor star BD+44°493 ([Fe/H] = −3.7), and set a very low upper limit for its Be abundance: $A(\mathrm{Be}) < -2.0$. It may indicate that the decreasing trend of Be abundances with lower [Fe/H] still holds at [Fe/H] < −3.5, and demonstrate that high C and O abundances do not necessarily imply high Be abundances. However, since the star is a subgiant with $T_{\mathrm{eff}} \sim 5500$K, Be may be depleted.

Keywords. stars: abundances, individual (BD+44°493), Population II

1. Observation and analysis

High-resolution spectroscopy of BD+44°493 was carried out with Subaru/HDS. The atmospheric parameters that we adopt are $T_{\mathrm{eff}} = 5510$ K, and $\log g = 3.7$. Our 1D LTE abundance analysis derives [Fe/H] = −3.7, [C/Fe] = +1.3, and [O/Fe] = +1.6, indicating that this star is a carbon-enhanced metal-poor (CEMP) star. Its abundance pattern implies that a first-generation "faint" supernova (e.g., Tominaga *et al.* 2007) is the most likely origin of its carbon excess. See Ito *et al.* (2009) for detail.

2. Implications of its low beryllium abundance

We set a very low upper limit for its Be abundance ($A(\mathrm{Be}) < -2.0$). This is the Be abundance reported at the lowest metallicity yet achieved, and is the lowest Be limit so far for metal-poor dwarfs or subgiants that have normal Li abundances. The result indicates that the decreasing trend of Be abundances with lower [Fe/H], which was revealed by previous studies (e.g., Boesgaard *et al.* 1999), still holds at [Fe/H] < −3.5 (Fig. 1).

Our analysis is the first attempt to measure a Be abundance for a CEMP star. Since Be is produced via the spallation of CNO nuclei, their abundances, especially O abundances, have been expected to correlate with Be abundances. However, our low Be upper limit shows that the high C and O abundances in BD+44°493 are irrelevant to its Be abundance (Fig. 1), which offers a new insight into the origin of CEMP stars.

3. Possibility of depletion

Previous studies of Be abundances in metal-poor subgiants indicate that Be is depleted in those with $T_{\mathrm{eff}} < 5500$K, so BD+44°493 is at the boundary (Fig. 2). In Ito *et al.* (2009), we adopt $T_{\mathrm{eff}} = 5510$ K determined by Carney *et al.* (2003), and assumed that Be in the

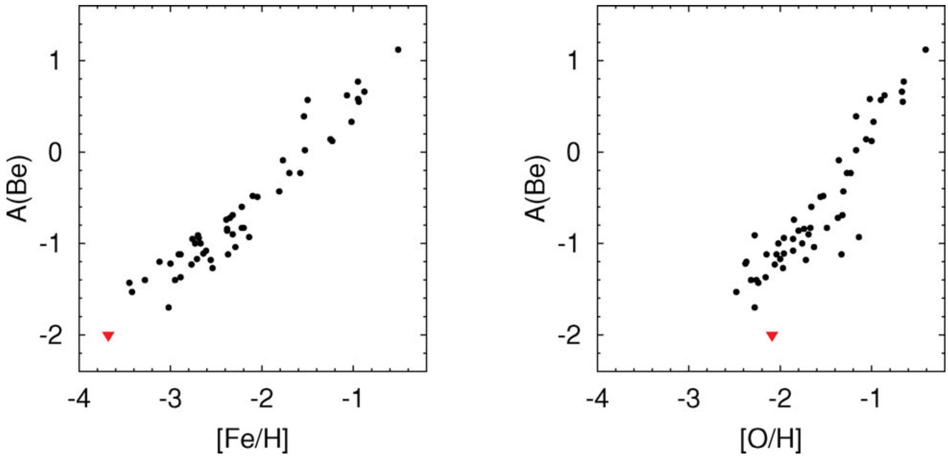

Figure 1. A(Be) vs. [Fe/H] and A(Be) vs. [O/H]. Our upper limit for BD+44°493 is shown by the red triangle. The filled circles indicate results of Rich & Boesgaard (2009).

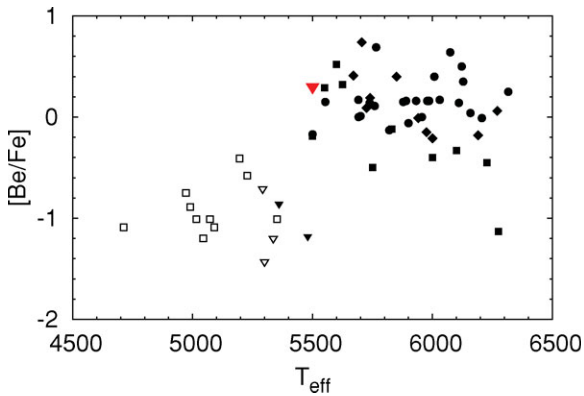

Figure 2. [Be/Fe] as a function of $T_{\rm eff}$. Our upper limit for BD+44°493 is shown by the red (bigger) triangle above the centre of the figure. Filled circles and diamonds indicate results of Rich & Boesgaard (2009) and Tan *et al.* (2009), respectively. Filled squares and (smaller) triangles those of Smiljanic *et al.* (2009), and the open ones those of García Pérez & Primas (2006). All triangles represent upper limits. Only subgiants ($\log g < 4.0$) are plotted.

star is not depleted. However, Carney *et al.* (2003) seems to overestimate the reddening, and our re-estimate lowers its temperature by about 100K (Ito et al. in prep.), increasing the possibility of Be depletion. We cannot conclude whether its Be is depleted, but if it is, our interpretation of its low Be abundance needs to be revised.

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