ABUNDANCE ANALYSIS OF SIX LMC F SUPERGIANTS

ANDREW McWILLIAM, ROBERT E. WILLIAMS
Cerro Tololo Inter-American Observatory
Casilla 603
La Serena
Chile

ABSTRACT. We have performed an abundance analysis of six Large Magellanic Cloud (LMC) F supergiants, based on infrared photometry and echelle spectra obtained from CTIO. We find a real dispersion in Fe/H values, indicating that the LMC is inhomogeneous. Oxygen abundances appear to be equal in all six stars, resulting in a steep O/Fe slope with Fe/H. Other element abundances appear near normal, although there is a hint of a small enhancement of second s-process peak elements. Iron abundances are probably affected by non-LTE; this does not change our conclusions concerning oxygen.

1. Observations

Six LMC F supergiants, chosen from Grieve and Madore's list (1986) of non-variable stars, were observed with the CTIO 4m telescope and echelle spectrograph with GEC CCD at a resolving power of 18,000. Typical S/N ratios of the final spectra were near 100. We also obtained infrared J and K photometry using the CTIO 1.5m telescope and InSb detector.

2. Analysis

Effective temperatures were determined from the V-K, V-J and J-K colours using the calibration of McWilliam (1990). Estimates of the reddening for each star were based on optical and IR photometry and the spectral type assignments. Stellar log g values were computed using an approximate mass found by placing the stars on the theoretical evolutionary tracks of Maeder and Meynet (1988). Model atmospheres were interpolated from the grid of Kurucz (1979), and abundances computed from the measured equivalent widths using an LTE spectrum synthesis program. Microturbulent velocities were found by forcing the computed iron abundances to be independent of equivalent width.

3. Results

Table 1 lists metal abundance ratios, [M/Fe], relative to the solar abundance distribution. The abundance ratios were taken relative to Fe I or Fe II lines, depending on the sensitivity of the ratios to uncertainties in the model atmosphere parameters.

Fe I abundances are systematically lower than Fe II abundances by 0.2 dex, probably due to non-LTE. There is a real dispersion in ε(Fe), indicating an inhomogeneous LMC ISM. The

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oxygen abundance is approximately constant, at ε(O) = 8.67 for the six supergiants, resulting in a gradient of [O/Fe] with [Fe/H] which is much steeper than seen in the Galaxy. Other α elements, such as Mg, Si, Ca and Ti do not follow the trend of O/Fe with Fe/H. A slight enhancement in the second s-process peak elements would vanish if ratioed with Fe II abundances, rather than Fe I, as would be more appropriate if Fe I lines are significantly affected by non-LTE.

Table 1. Abundances relative to iron

[M/Fe]	G231	G274	G406	G439	G538	G501
C I	−0.54	−0.16	−0.32	−0.44	−0.52	−0.78
O I	−0.31	0.00	0.16	0.34	−0.02	0.17
Na I	0.21	−0.02	0.09	0.02	0.05	−0.09
Mg I	−0.01	0.01	−0.10	−0.08	−0.13	−0.10
Si I	0.55	0.28	0.36	0.32	0.38	0.32
Ca I	0.04	0.23	0.09	0.03	0.03	0.15
Ca II	0.15	0.28	0.36	0.11	0.13	0.46
Sc II	−0.04	0.01	−0.10	−0.12	−0.10	−0.20
Ti I	0.12	0.07	0.15	−0.06	0.23	0.28
Ti II	0.05	0.29	0.22	0.27	0.37	0.34
V I	−0.41	−0.47	−0.70	−0.73	−0.64	...
V II	0.01	0.10	0.01	0.20	−0.22	...
Cr I	−0.20	−0.05	−0.19	−0.03	−0.05	−0.33
Cr II	0.02	0.11	0.06	0.04	0.03	0.03
Mn I	−0.12	−0.33	−0.41	−0.32	−0.35	−0.47
Mn II	...	−0.52	−0.51	...	−0.57	−0.71
Co I	−0.99	−1.02	−1.10	−0.52	−0.89	−0.53
Ni I	0.00	−0.12	−0.14	−0.29	−0.17	−0.12
Zn I	−0.18	−0.51	−0.19	−0.33	−0.27	0.00
Y II	−0.03	−0.08	0.10	−0.02	0.11	0.02
Zr II	−0.06	0.14	0.04	0.16	0.25	−0.34
Ba II	0.41	0.19	0.29	0.45	−0.06	0.32
La II	0.10	0.20	0.33	0.38	0.16	0.25
Ce II	0.16	0.47	0.38	0.51	0.46	0.43
Pr II	...	0.09	0.19	0.12	0.28	0.16
Nd II	0.19	0.34	0.32	0.37	0.38	0.28
Sm II	0.16	0.21	0.38	0.42	0.30	0.25
Gd II	−0.83	−0.41	−0.30	−0.26	−0.34	...
Dy II	...	0.53	0.00	0.34	0.28	0.05
Hf II	0.43	0.31	0.57	0.79	0.14	0.08
[Fe I/H]	−0.27	−0.44	−0.62	−0.68	−0.42	−0.62
[Fe II/H]	−0.05	−0.28	−0.34	−0.58	−0.18	−0.33

5. References

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