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Magnesium abundance in main sequence B-type and magnetic chemically peculiar stars

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Abstract. The abundance of magnesium for a sample of 19 main sequence B-type and 41 magnetic chemically peculiar stars has been derived by spectrum synthesis analysis of the MgII 448.1 nm line under the LTE assumption. The logarithm of the average Mg abundance for the main sequence stars is log (N(MgII)/N(Tot)) = -4.28 ± 0.19. Comparing magnetic chemically peculiar (Cp) and main sequence stars with equal effective temperature and gravity, one finds that the magnesium abundance tends to be lower in peculiar stars with the exception of helium rich stars where this element can be overabundant.

In Cp stars with effective temperature of about 14000 K, the magnesium abundance does not depend on gravity, microturbulent velocity or rotational period. There appears to exist a correlation between the magnesium abundance and the surface magnetic field, with the stars poorest in magnesium presenting the strongest magnetic fields.

In accord with the theory of magnetically controlled diffusion – which predicts a non-homogeneous distribution of magnesium over the stellar surface and stratification in the photosphere – some peculiar stars show evidence of spectral variability with the rotational phase; the respective magnesium abundances of the HgMn stars HD 49606 and HD 78316 depend on optical depth.

Key words: stars: abundances – stars: chemically peculiar – stars: early-type

1. Introduction

Michaud (1970) has proposed that radiative diffusion processes are at the origin of the non solar abundances characterising magnetic chemically peculiar (Cp) stars. As to magnesium, Michaud's calculations show that the radiation force due to photoionisation is smaller than the gravitational force over the whole range of effective temperatures. This is consistent with Adelman's (1973) finding of magnesium underabundance (with respect to the solar value) in a sample of 21 cool Cp stars. By Radiative acceleration calculations for stellar atmosphere of main sequence stars (log g = 4.0) with effective temperatures equal to 10000, 12500 and 15000 K, Borsenberger et al. (1984) have shown that solar magnesium abundance cannot be supported. Smith (1993) has found that magnesium in HgMn stars is underabundant with respect to the sun, even though the predictions of diffusion theory are not verified in detail.

With the aim of studying the behaviour of magnesium in Cp stars belonging to different subclasses, we have performed spectroscopy of the MgII 448.1 nm line for 41 of these stars. A sample of 19 main sequence B-type stars, with effective temperatures covering the range of peculiar stars, have also been observed in order to compare the observed behaviour of magnesium in Cp stars with theoretical predictions.

Cp stars are characterised by a mainly dipolar magnetic field whose symmetry axis is tilted with respect to the rotational axis. Diffusion being governed by magnetic fields, a non-homogeneous distribution of magnesium is expected on the stellar surface. The expected non homogeneous distribution of magnesium on the stellar surface should be reflected in spectral line variability, so most of the selected Cp stars have been observed several times.

2. Observations and data analysis

For the main sequence B-type and peculiar stars listed in Table 1 and Table 2 respectively, echelle spectra with R = 26000 and covering the 400 - 700 nm range have been obtained in the time from December 5 to 11, 1995 at the 2.1 m telescope at CASLEO, using a Boller & Chivens cassegrain spectrograph. Data have been reduced by means of the IRAF package. The S/N ratio

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Several codes have been employed in the analysis of the observed spectra: ATLAS9 (Kurucz 1993) to compute atmospheric models, SYNTHE (Kurucz & Avrett 1981) to identify spectral lines, WIDTH9 (Kurucz & Avrett 1981) to derive abundances from unblended lines, and XLINOP9 (Kurucz priv. comm.) to derive abundances from blended lines. The atomic parameters adopted are from Kurucz (1993). The Kurucz programs work in the LTE approximation; including about 5.8×10^7 lines they are still most suitable for the treatment of line-blanketing in metal-rich peculiar stars. ATLAS9 uses opacity distribution functions (ODFs) which have been computed for scaled solar metal abundances. We have used ODF=[0.0] dex for main sequence stars and ODF=[+1.0] dex for Cp stars with enhanced iron and silicon abundances.

The MgII 448.1 nm multiplet is given by the fine structure transitions at 448.1126, 448.1150 and 448.1325 nm. We have derived the magnesium abundance by using XLINOP9. Our LTE approach is justified by the results of Gigas (1988) who has shown that NLTE abundance corrections are not very pronounced for MgI and MgII – the largest abundance correction (for the MgII448.1 nm line) is equal to -0.10 dex. We shall show that this is less than the abundance uncertainties due to errors in the stellar parameters.

The microturbulent velocity ξ for each star has been determined from unblended lines by minimising the scatter of the iron, silicon and/or oxygen abundances derived, with the additional requirement that they be independent of equivalent width. The adopted step size was $\Delta\xi = 0.1\,\mathrm{km\,s^{-1}}$. According to Kilian (1994) who has compared the LTE and NLTE metal abundances for B-type stars, differences in the silicon abundances based on LTE line formation calculations are smaller by 0.2 dex and microturbulent velocities computed from oxygen lines are 1-2 $\mathrm{km\,s^{-1}}$ higher than the corresponding NLTE values at effective temperatures below 27000 K. Our microturbulence velocities are listed in Table 1 and Table 2. For those stars where the microturbulent velocity cannot be inferred from our spectra we have assumed a representative value of $\xi = 2\,\mathrm{km\,s^{-1}}$ for the subsequent analysis.

The effect of magnetic fields has not been explicitly included in the determination of magnesium abundances in magnetic chemically peculiar stars; this problem would require detailed knowledge of the magnetic geometry and the element distribution, which at present is not available. Assumining that the natural, Stark and van der Waals broadening are Lorentzian functions and that the thermal absorber velocity distribution is Maxwellian, the line profile is easily represented by means of a multiple convolution resulting in the Voigt function. Usually the thermal motion of absorbers is not large enough to explain the observed equivalent widths and a microturbulent motion is supposed. If the velocity distribution of the microturbulent motion is still Maxwellian, the thermal absorber motion and the microturbulent motion can be represented with two Gaussian functions whose variances respectively are $v_{ther.}$ and $v_{turb.}$. Being the convolution of these two Gaussian functions a Gaussian with variance $\sqrt{v_{ther.}^2 + v_{turb.}^2}$, it is still possible to represent the line profile with a Voigt function (Gray 1976). With respect to *normal* stars, the spectral lines of magnetic chemically peculiar stars are also broadened from the Zeeman splitting. *Ad hoc* procedures have been used to quantify the magnetic field line broadening (see for example Preston 1971, Adelman 1973). Following Adelman (1973), the Zeeman intensification of a line can be quantified defining a pseudo-microturbulent velocity given by the expression:

$$v_H = 1.4 \times 10^{-6} \lambda\ g_{eff} H\ \ km\, s^{-1} \tag{1}$$

where λ is the line central wavelenght in nm, g_{eff} is the Landè factor and H the magnetic field in gauss. Within Adelman hypothesis, the line desaturation due to the magnetic field is quantified through $\xi = \sqrt{v_{turb.}^2 + v_H^2}$ and line profiles are still represented with a simply Voigt function. The quantity ξ is determined with the previous described method used for the microturbulent velocity.

3. Effective temperatures and gravities

The effective temperatures and gravities of the main sequence stars have been derived from Strömgren photometry according to the grid of Moon & Dworetsky (1985) as coded by Moon (1985). The photometric colors have been de-reddened with the Moon (1985) algorithm. The source of the Strömgren photometric data was SIMBAD. For the star HD 886, whose Strömgren photometric data were not available, we have assumed the respective effective temperatures and gravities given by Gies & Lambert (1992). Being Strömgren photometric data of HD 72798 also not available, we have inferred the effective temperature by using Cramer & Maeder (1980) method which is based on Geneva photometry.

Because of the abundance anomalies which modify the flux distribution of chemically peculiar stars (Leckrone et al., 1974), *classical* methods cannot be used to estimate the effective temperature of these stars and *ad hoc* methods are necessary (see e.g. Napiwotzki et al. 1993). We have preferred to adopt the effective temperatures of Cp stars reported in the literature if it was derived with high accuracy. As to the HgMn stars present in our sample, viz. HD 49606 and HD 78316, we have adopted the effective temperatures given by Smith (1993). As to the helium weak stars HD 28843, HD 37058, HD 49333, we have chosen the effective temperatures given by Hauck & North (1993). Computing atmospheric models with ATLAS9 (Kurucz 1993), Catalano & Leone (1996) have found that solar and zero helium abundance atmospheres are indistinguishable from each other when one looks solely at the flux distribution. This result is consistent with the conclusion reached by Hauck & North (1993) that *classical* photometric methods can be used for the determination of the effective temperatures of helium weak stars. Peculiar abundances of other species may be responsible for anomalous flux distributions in helium weak stars; for these

Table 1. Measured equivalent widths of the Mg II 448.1 nm line for the observed main sequence B-type stars. Spectral types (ST) are taken from the *Bright Star Catalogue* (Hoffleit & Jaschek 1982). Effective temperatures and gravities have been determined following Moon (1985) with the exception of HD 886 and HD 72798 (see text). Rotational velocities are from the SIMBAD database. Microturbulent velocities have been estimated as described in the text.

$Star$ HD	$ST + PC$	$T_{\rm eff}$ K	$\log g$	$v_e \sin i$ $km\,s^{-1}$	ξ $km\,s^{-1}$	EW mÅ	Reference
886	$B2IV$	22700	4.02	5	2.7	140	Gies &Lambert (1992)
2884	$B9V$	10900	4.34	173		350	
15318	$B9III$	10200	4.07	62	1.9	400	
16582	$B2IV$	21500	3.44	22	6.1	170	
24626	$B6V$	14300	4.06	35	0.5	290	
35039	$B2IV-V$	19850	3.40	10	4.2	200	
35299	$B1.5V$	22700	3.87	30	3.8	150	
42690	$B2V$	19400	3.58	15	3.9	190	
43107	$B8V$	10800	3.91	121		400	
45813	$B4V$	16200	3.99	138		260	
56779	$B2IV-V$	17850	3.76	132		210	
62542	$B3V$	15150	3.80		1.7	270	
72350	$B4IV$	15000	3.50			270	
72798	$B3III$	15600	3.50		2.4	250	Cramer & Maeder (1980)
74280	$B3V$	18400	3.76	128		230	
75821	$B0III$	23650	3.90	50		110	
80007	$A2IV$	9000	3.21	145		440	
210424	$B7III$	13850	3.98	18	1.9	290	
214923	$B8V$	11200	3.73	194		390	

stars in our sample we have derived the respective iron and silicon abundances by adopting temperature and gravity given by the Moon algorithm. When these abundances were close to the solar abundances, we retained these temperatures and gravities, otherwise we used the method of Napiwotzki et al. (1993) to estimate the effective temperatures of the helium weak stars. As to helium rich stars, effective temperatures have been taken from the literature whenever possible or estimated by using Moon's algorithm. The effective temperatures of the remaining peculiar stars result from application of the method of Napiwotzki et al. (1993).

Gravities have been derived following Moon and applying corrections according to Napiwotzki et al. (1993). Table 1 and Table 2 respectively list the adopted effective temperatures and gravities for main sequence and Cp stars together with the bibliographic references.

4. The behaviour of the Mg II 448.1 nm line in main sequence stars

Measured equivalent widths of the Mg II 448.1 nm line for the program main sequence stars are listed in Table 1. Figure 1 displays the dependence of the equivalent width of the Mg II 448.1 nm line on the effective temperature. In the selected range of effective temperatures, the following linear relation appears to hold:

$$\mathrm{EW(Å)} = 0.61 - 0.02 \times \mathrm{T_3(K)} \qquad (2)$$

where $T_3 = T_{\rm eff}/1000$.

The logarithm of the average magnesium abundance is $\log(\mathrm{N(Mg)/N(Tot)}) = -4.28 \pm 0.19$. This abundance is close to the value $\log(\mathrm{N(Mg)/N(Tot)}) = -4.30 \pm 0.22$ which has been derived by Smith (1993) from ultraviolet lines and to the values given by Adelman (1987), viz. $\log(\mathrm{N(MgI)/N(Tot)}) = -4.23$ and $\log(\mathrm{N(MgII)/N(Tot)}) = -4.29$.

How errors in the determination of effective temperature, gravity, microturbulent velocity and measurement errors in equivalent width affect the abundance determination cannot be estimated in a straightforward way. According to Napiwotzki et al. (1993) the error in the effective temperature ranges from 2.5% at $\mathrm{T_{eff}} < 11000$ K up to 4% at $\mathrm{T_{eff}} > 20000$ K. Errors in the adopted gravities range from 0.10 dex for A-type stars to 0.25 dex for hot B-type stars. Errors in the microturbulent velocity resulting from the LTE approximation are expected to be as high as $2\,\mathrm{km\,s^{-1}}$ (see Kilian 1994). Empirically converting all these errors to abundance errors, we find that a 0.3 dex error in the magnesium abundances of main sequence stars would not come as a surprise.

For effective temperatures ranging between 12000 and 20000 K, $\log \mathrm{g} = 4.0$ and $\xi = 2.0\,\mathrm{km\,s^{-1}}$, we have found that the logarithmic abundance is related to the equivalent width (EW) and to the effective temperature by the simple relation:

$$\log\frac{\mathrm{N(Mg)}}{\mathrm{N(Tot)}} = -8.47 + 0.1 \times T_3 + (5.27 + 0.26 \times T_3) \times EW(\mathrm{Å}) \qquad (3)$$

For stars with $\log \mathrm{g} \neq 4.0$ and $\xi \neq 2.0\,\mathrm{km\,s^{-1}}$, the comparison between the magnesium abundance and the approximate value

Table 2. Measured equivalent widths for peculiar stars. The peculiarity class is from the *General catalogue of Ap and Am stars* (Renson et al. 1991), the stellar rotational period from the *Catalogue of observed periods for the Ap stars* (Catalano & Renson 1984) and its supplements. Together with the mean EW, also given are the number of measurements and the standard deviation σ.

$Star$ HD	$ST+PC$	$T_{\rm eff}$ K	$\log g$	$v_e \sin i$ $km\,s^{-1}$	ξ $km\,s^{-1}$	$Period$ $days$	N	$<EW>$ mÅ	σ mÅ	Reference
3580	$B8Si$	13250	3.82	85	1.1	1.5	3	115	17	
5737	$B6He-weak$	14000	3.50	7	1.1	21.6	1	230		Cayrel de Strobel et al. (1992)
12767	$A0Si$	12800	3.89	80	2.9	1.9	5	180	25	
19400	$B8He-weak$	13350	3.76	44	1.0		5	208	4	
22470	$B9Si$	13450	4.15	80	3.0	1.9	2	230	0	
22920	$B8Si$	14150	3.72	121	1.3	3.9	5	150	5	
24155	$B9Si$	13700	3.96	45	1.5	2.5	4	175	15	
24587	$B6?$	13350	4.23	29	1.5		3	200	10	
26571	$B8Si$	13200	3.16			1.1	1	180		
28843	$B9He-weak$	15300	4.25		3.0	1.4	5	170	52	Hauck & North (1993)
33331	$B7He-rich$	13200	4.11	50	0.4	1.1	4	310	15	Olsen (1977)
34797	$B8He-weak$	13000	4.25	80	1.6	2.3	5	170	7	
35456	$B7He-weak$	13450	3.79	25	1.6		5	150	15	
35502	$B6SrCrSi$	14700	4.42	290		1.7	4	170	20	
35575	$B3He-weak$	16500	4.07	120			1	205		
35730	$B4He-weak$	17600	4.15	58	1.1		1	170		Moon & Dworetsky (1985)
36485	$B2He-rich$	19000	4.22	32	2.2	1.7	5	245	6	Bohlender (1992)
36589	$B7?$	12900	3.97	90			1	215		
36629	$B3He-weak$	17600	3.62	5			1	170		
36916	$B8He-weak$	13500	3.77	75	1.8	1.6	4	150	22	
37017	$B2He-rich$	23750	4.02	150		0.9		200		Shore & Brown (1990)
37058	$B3He-weak$	20250	4.00	5	0.6	14.6	1	200		Hauck & North (1993)
37479	$B2He-rich$	24000	3.86	150		1.2		190		Shore & Brown (1990)
37776	$B3He-rich$	22500	4.11	145		1.5		275		Shore & Brown (1990)
37808	$B9Si$	13550	4.07	30	1.1	1.1	5	245	12	
38602	$B9Si$	11900	3.61	100	1.0	2.6	5	300	8	
44953	$B8He-weak$	15000	4.18		1.0		1	245		
49333	$B7He-weak$	16800	4.08	65	1.7	2.2	5	205	4	Hauck & North (1993)
49606	$B8HgMn$	14400	3.89	35	1.2	3.3	5	220	8	Smith (1993)
58260	$B3He-rich$	19000	3.52	18		1.5	5	170	3	Bohlender (1989)
58448	$B8Si$	10700	4.34			0.8	4	245	8	
60344	$B3He-rich$	16600	3.50	15		1.8	1	170		
64740	$B2He-rich$	19900	3.80	140		1.3		290		
65575	$B3Si$	15500	3.54	110	1.0		4	220	8	
66522	$B2He-rich$	17500	3.51	30		6.8	3	150	8	
73340	$B9Si$	14000	4.02		1.3	2.7	5	140	16	
74560	$B3MgSi$	15300	3.92	22	3.0	1.5	2	230	14	
78316	$B8HgMn$	13500	3.78	6	0.8		1	210		Smith (1993)
79416	$B8Si$	14300	4.10	384	1.1	2.9	3	140	10	Moon & Dworetsky (1985)
79469	$A0He-weak$	10100	4.19	100	1.1			310		
224926	$B8He-weak$	13600	3.72	80	2.0		2	225	7	

given by Eq. (3) shows that differences generally do not exceed 0.05 dex. Only for very small gravities and microturbulent velocities differences can reach 0.5 dex.

5. The behaviour of the Mg II 448.1 nm line in magnetic chemically peculiar stars

Table 2 gives the measured equivalent widths for chemically peculiar stars. Figure 1 shows that in general the equivalent width of the Mg II 448.1 nm line in the observed magnetic chemically peculiar stars is smaller than in main sequence stars of equal effective temperature, with the exception of the hottest helium rich stars.

Converting the equivalent widths to abundances, we find that Cp stars can be underabundant in magnesium with respect to main sequence stars with the same effective temperature. Only the hottest stars can be overabundant (Fig. 2).

Errors in magnesium abundance determinations for Cp stars are expected to be larger than for main sequence stars because of

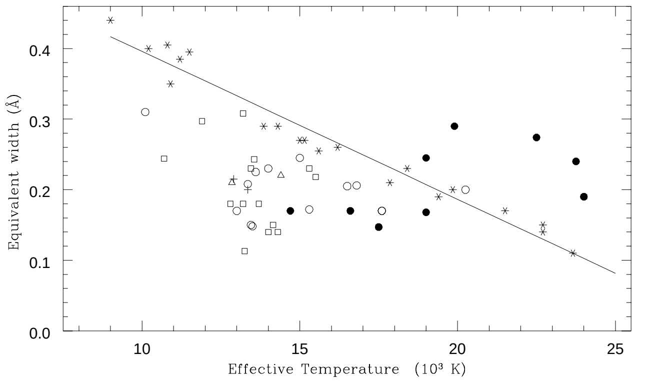

Fig. 1. Observed equivalent widths for main sequence B-type and magnetic chemically peculiar stars. ∗ represent main sequence stars, • helium rich stars, ○ helium weak stars, □ silicon stars, △ HgMn stars, + stars whose peculiarity class has not been given in Renson et al. (1991) catalogue.

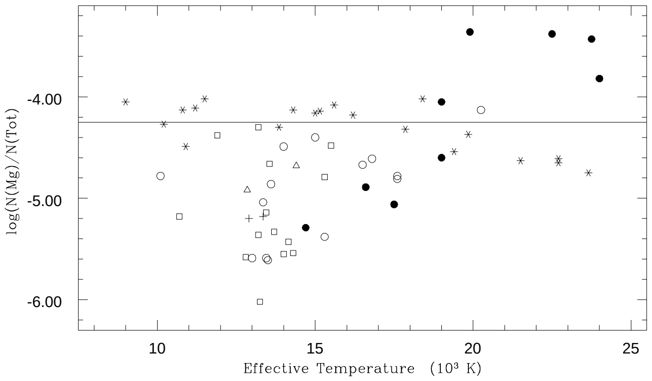

Fig. 2. Abundance inferred from the Mg ii 448.1 nm line for main sequence and magnetic chemically peculiar stars. The average magnesium abundance for main sequence stars is displayed as a straight line. The symbols have the same meaning as in Fig. 1.

a possible systematic error of the order of 2% caused by the Infrared Flux Method used by Napiwotzki et al. (1993). Moreover, atmospheric models are computed with ODFs which are representative of *scaled solar opacities*; for peculiar stars we have adopted a solar metal opacity (ODF=[0.0]) if the iron and silicon abundances were less than five times solar, and ODF=[+1.0] if the abundances were more than five times solar. Deriving the magnesium abundances for atmospheric models of equal effective temperature and gravity but with ODFs different by a factor of ten, we have found that an upper limit to the error in the magnesium abundance due to the metal opacity is of the order of 0.1 dex. We conclude that the magnesium abundances for Cp stars carry a possible error of 0.35 dex.

5.1. The dependence of the underabundance on stellar parameters

Figure 2 shows that in Cp stars magnesium is generally underabundant but without any dependence on peculiarity subclass. According to the diffusion calculations of Borsenberger et al. (1984), the magnesium abundance drops to one third at $T_{\rm eff}$ = 15000 and 12500 K, to one tenth of the solar value at $T_{\rm eff}$ = 10000 K. Smith (1993), in a study of the behaviour of magnesium in HgMn stars, found that only *qualitatively* are the calculations of Borsenberger et al. (1984) in agreement with observations. As to Cp stars, we observe a general increase in magnesium abundance with effective temperature and even an overabundance for the hottest helium rich stars. Nevertheless, we observe several Cp stars with similar effective temperature but very different magnesium abundances.

Borsenberger et al. (1984) have pointed out the importance of microturbulence in modifying the atmosphere abundances. To investigate how magnesium diffusion depends on microturbulence and other stellar parameters, we have selected the Cp stars with effective temperature between 12800 and 14300 K; in Fig. 3 the observed abundances are plotted versus the respective microturbulent velocities, surface gravities, rotational periods and surface magnetic fields (determined via the Geneva index Z with the help of the Cramer & Maeder (1980) method).

Following Press et al. (1986), possible linear relations between the magnesium abundance of Cp stars and their stellar parameters are estimated using Pearson's r coefficient – remember that prefect correlation implies r = 1, perfect anticorrelation $r = -1$. The probability p that $|r|$ should be larger than its observed value in the null hypothesis (r = 0) is also computed – remember that a small value of p indicates a significative correlation. For our sample the relation between magnesium abundance and microturbulence gives $r = -0.13$ and $p = 0.57$, with gravity we have $r = -0.05$ and $p = 0.72$, with the rotational period $r = -0.13$ and $p = 0.65$, and with the surface magnetic field $r = 0.48$ and $p = 0.03$ i.e. only the correlation between the magnesium abundances and the surface magnetic field attains a significant level.

5.2. Magnesium stratification in HgMn stars

According to Borsenberger et al. (1984), magnesium is expected to become underabundant and stratified in the stellar atmosphere. The ultraviolet Mg ii lines observed by Smith (1993) at 279.0, 279.8, 292.8 and 293.6 nm and the Mg ii 448.1 nm line respectively are formed in different atmospheric layers and can be used to ascertain the stratification in the HgMn stars HD 49606 and HD 78316. The contribution functions for these lines – computed as described by Gray (1992) – for an atmospheric model with $T_{\rm eff}$ = 14000 K and log g = 3.9 are shown in Fig. 4. Since we have adopted the atmospheric models used by Smith (1993) and since this author too has used the Kurucz SYNTHE code, we can immediately compare the derived magnesium abundances. For both HgMn stars, the magnesium abundance derived changes with the optical depth (Fig. 4) which could be indicative of magnesium stratification in accord with the Borsenberger et al. (1984) calculations. See Fig. 3 of Borsenberger et al. (1984) for the predicted magnesium abundance with optical depth due to diffusion processes.

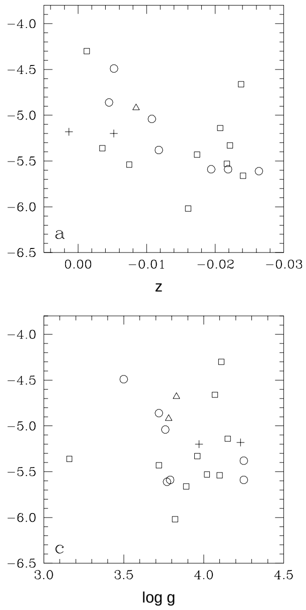

Fig. 3a–d. Dependence on different parameters of the Mg abundance derived from the MgII 448.1 nm line for chemically peculiar stars with $12800 < T_{\rm eff} < 14300$ K. In panel **b**, the star HD 5737 having a 21.6 day period has not be considered. In panel **d**, only stars with ξ determined are displayed. Symbols are the same as in Fig. 1.

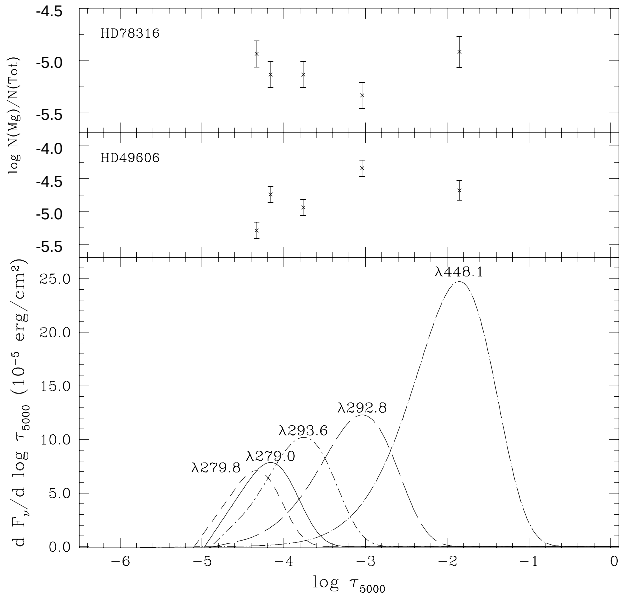

Fig. 4. Contribution functions for the respective central wavelengths of the MgII 448.1 nm line and of the MgII ultraviolet lines studied by Smith (1993). Abundances inferred from the previous lines for the HgMn stars HD 49696 and HD 78316. The error bars for the ultraviolet lines are from Smith.

5.3. Spectral variability

Table 2 lists the number of measures for each peculiar star together with the average equivalent width and the standard deviation. Since the principal error in equivalent width measurements comes from the continuum determination, it can be roughly represented (expressed in Å) by the relation (Leone et al. 1995):

$$\frac{1}{2}\left(2\frac{v_{\rm e}\sin i}{c}4481\right)\frac{1}{S/N}$$

where the quantity in brackets is the total extension of the line due to the rotational broadening. S/N ranging between 150 and 200, we would conclude that errors in the equivalent width measures never exceed 10Å, so that the largest σ values can be considered indicative of real intrinsic variations.

Within the framework of diffusion theory in the presence of a magnetic field, a non-homogeneous distribution of elements is expected for stars presenting a magnetic dipole field. It is possible to consider the variable equivalent widths as evidence for such a non-homogeneous distribution.

6. Conclusions

By LTE spectrum synthesis analysis of the MgII 448.1 nm line we have determined the magnesium abundance for a sample of magnetic chemically peculiar stars belonging to different peculiarity subclasses. In addition, some main sequence B-type covering the effective temperature range of peculiar stars have been observed to ascertain the behaviour of magnesium in *normal* stars and to test our computational method.

With respect to main sequence stars with equal effective temperature and gravity, magnesium is generally underabundant in peculiar stars with the exception of the hot helium strong stars where this element can even be overabundant. Looking for a correlation between the magnesium abundances and the stellar parameters, it appears that the stars poorest in magnesium present the strongest surface magnetic field. Combining the magnesium abundances for the two HgMn stars present in our sample with the abundances derived by Smith (1993) from ultraviolet lines, it appears that the magnesium abundance changes with the optical depth. This result is consistent with the stratification predicted by the diffusion theory (Borsenberger et al. 1994). Some of the Cp stars, which have been observed several times, show evidence of spectral variability of the MgII 448.1 nm line. According to the diffusion theory in presence of a magnetic field, the observed spectral variability could be due to the non-homogeneous distribution of magnesium on stellar surface.

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