Chemical Composition of HD 27381 and HD 13759

There has been considerable interest in the chemical composition studies of stars in various stages of evolution, as they provide diagnostic tools to examine the predictions made by theories of stellar evolution. Of particular interest among evolved stars are the post-AGB stars, where the abundance peculiarities resulting from evolutionary processes are manifested in a relatively short time scale. A fairly large number of post-AGB stars have been studied in the last two decades. Within them, a few distinct subgroups have been identified.

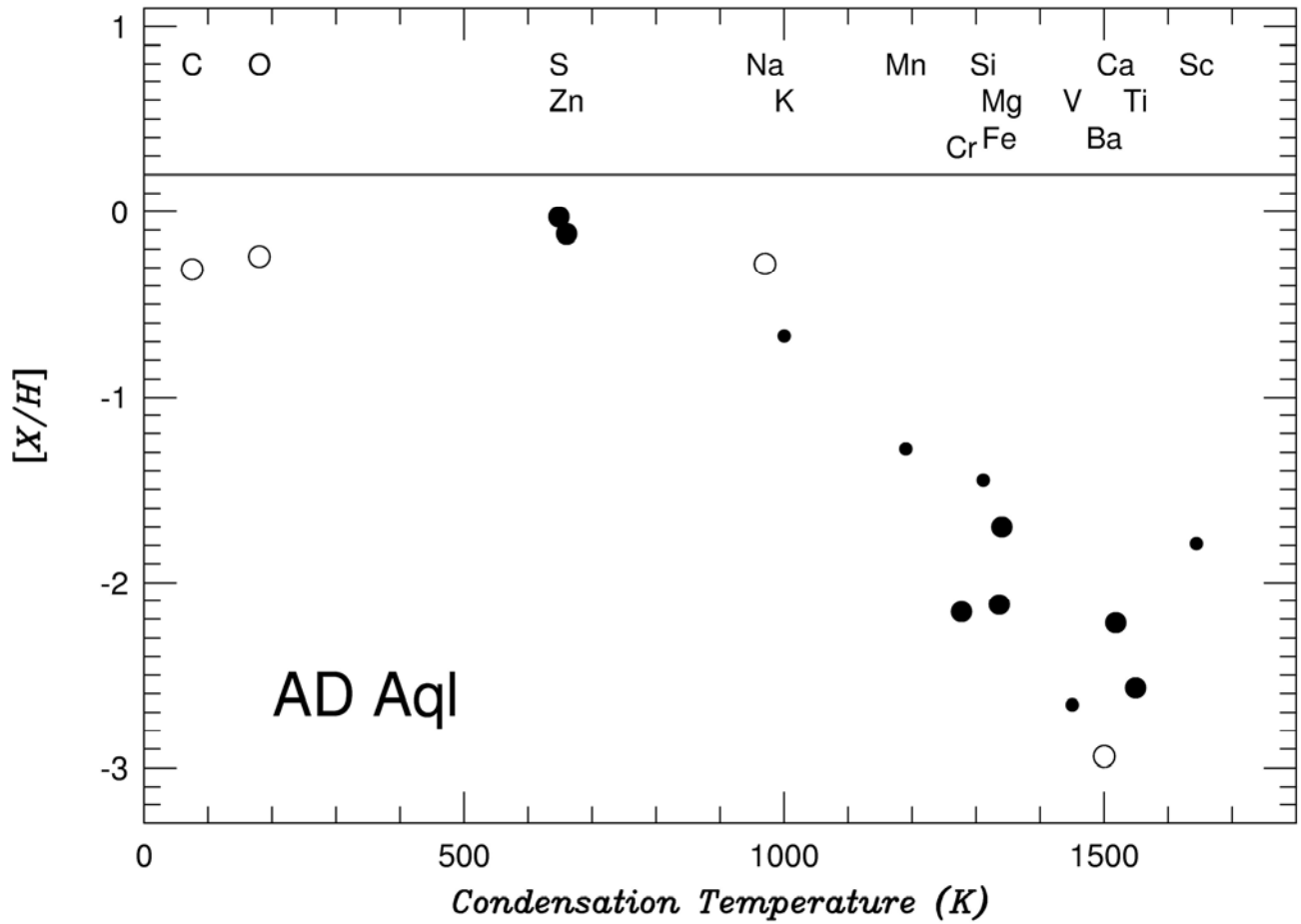
1. Most glamorous group containing stars with C/O > 1, displays considerable enhancement of s-process elements. Typical examples are HD 56126, HD 187785 and IRAS06530-0213

   These objects show two peaks in their Spectral Energy Distribution (SED) and their metallicity ranges between [Fe/H]=-0.3 to-1.0.

2. The O-rich post-AGB stars (C/O < 1) do not display s-process enhancement but display double humped SED and metallicity range similar to that seen in C-rich AGB stars. The typical examples are 89 Her, HD 161796, HD 133656, SAO 239853 etc.
3. The group of post-AGB stars with C/O ~ 1 show abundance peculiarities caused by selective removal of refractory elements e.g. BD+39^{o}4926, HR 4049, HD 44179, HD 46703, HD 52961 etc. Although a large fraction of them are known to be binaries and the presence of IR fluxes lend further support to the idea of circumbinary disk as the site of dust-gas separation, However, BD+39^{o} 4926 is an exception with lack of detected IR fluxes although it is known to be a binary.

Although RV Tau stars are believed to be post-AGB(PAGB) objects, our first finding of this abundance peculiarity for RV Tau star IW Car came as pleasant surprise. Our continuous effort over the larger sample showed that many other RV Tau stars exhibited this effect e.g AD Aql, AC Her, EP Lyr, AR Pup, UY CMa, DY Ori etc gave clear manifestation of selective removal of refractory elements.

Among them AC Her, V Vul, RU Cen, and SX Cen are RV Tauri stars with a detected binary companion. The detection of binaries in RV Tauri stars is hampered by long periodicities of several hundred days.


C
O
S
Zn
Na
K
Mn
Si
Mg
Cr
Fe
V
Ca
Ti
Ba
Sc
AD Aql
[X/H]
Condensation Temperature (K)
1
0
-1
-2
-3
0
500
1000
1500

Hot post-AGB stars

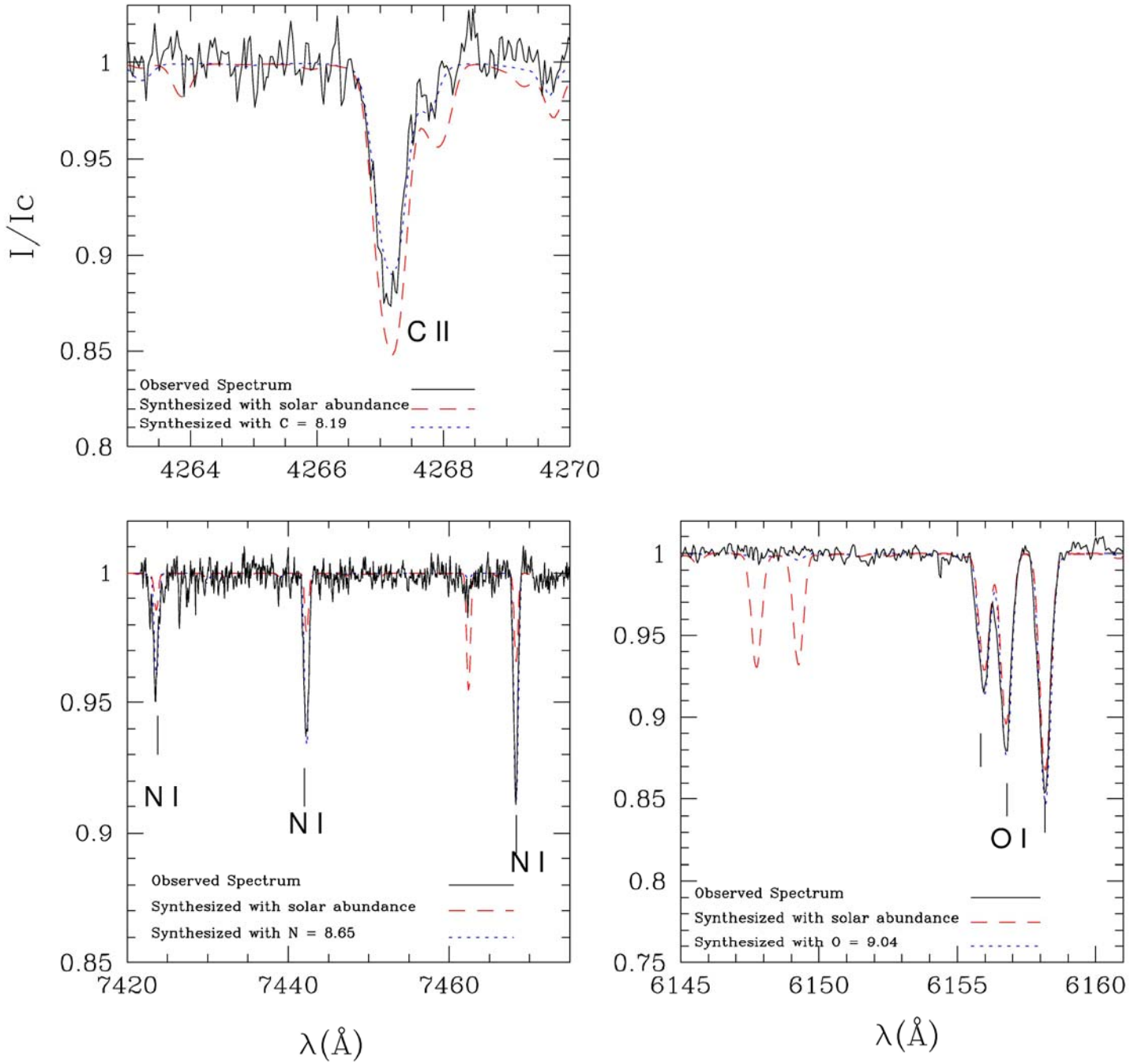
These objects were discovered among the high galactic latitude B supergiants which are metal-poor and show larger carbon deficiency and relative less deficiency of N,O,Mg,Si atc. IR excess is not seen in many of them. These objects were considered to be different from optically bright F type PAGS but stars such as HD 107369, HD 27381, HD 137569, PAGB stars in globular clusters like Bernard 29 etc give evidence that hot PAGB stars are quite similar to O-rich PAGB stars. It is likely that these objects have evolved from the relatively low mass end of PAGB precursors (1.5-3M$_\odot$) which have longer transition time and these objects would lose most of circumstellar matter before turning to PNe region.

HD 27381

This high latitude A type star has only moderate IR detection but our investigation showed this object to be a moderately metal-poor low gravity star with remarkable C deficiency of -1.0 dex and moderate enhancement of N while O is essentially unchanged, indicating the presence of CNO processed material but no indication of s-process enhancement. The temperature of this star is very similar to that of well-known PAGB like HD 44179, HD 158616 etc but this star together with HD 107369 shows a continuity between hot-PAGB star and cooler AGB stars.

HD 137569

This object is a high galactic latitude B9 star which is known to be a spectroscopic binary. From the photometric indices and Balmer jump index the temperature was estimated around 12000K. The gravity was estimated using the profiles of gravity sensitive HI and HeI line profiles. However, we were intrigued by the weakness of CII, MgII and SiII lines although HeI, OI, NI, NeI and SII lines were present. At 12000K the lines of FeII should have been discernible but even the strongest FeII line such as 4233A could not be detected.


I/Ic
C II
Observed Spectrum
Synthesized with solar abundance
Synthesized with C = 8.19
N I
N I
N I
Observed Spectrum
Synthesized with solar abundance
Synthesized with N = 8.65
O I
Observed Spectrum
Synthesized with solar abundance
Synthesized with O = 9.04
λ(Å)
λ(Å)

Star	T_{eff}	[C/H]	[N/H]	[O/H]	[Mg/H]	[Si/H]	[S/H]	[Fe/H]
HD44179	7500	-0.2	0.0	-0.4	-2.1	-1.8	-0.3	-3.3
HD27381	7500	-1.0	-0.5	-0.3	-0.7	-0.1	-0.3	-0.8
HD107369	8000	-1.3	-0.7	-1.1		-1.0	-1.0	-1.0
LSIV 4^o 1	11000	<-1.3			-2.0	-1.8		-1.7
HD137569	12000	-0.6	+0.2	+0.0	-2.8	-2.4	-0.1	<-3.0
LB3193	12900	<-1.9			-2.1	-2.1		
PG1323-086	16000	<-2.2	-1.0	-0.8	-1.7	-1.4		
PG1704+222	18000	-1.4	-0.9	-0.8	-1.4	-1.1		
PHL 174	18000	<-2.3	-1.1	-0.8	-1.4	-1.0		
Bernard 29	20000	-2.2	-0.6	-1.1		-1.2		-2.2
BD+33 2642	20200	-0.9	-0.6	-0.6	-1.1	-0.9		
LB3219	21400	-1.7	-0.3	-1.1	-0.6	-0.9		
LSIV -12^o111	24000	-0.8	+0.1	+0.1	-0.3	+0.1	-0.6	-0.4

It can be seen from the table that at the temperature of 7500K HD 44179 has the distinct signature of abundance peculiarities caused by the selective removal of the refractory elements while HD 27381 and HD 107369 have abundance pattern similar to the common hot-PAGB stars. Among hot-PAGB only LSIV -4^{o}.01, HD 137569 and LB 3193 show the same effect via depletion of Mg, Si and Fe while S remains solar.

The similarity of the abundance pattern of hot-PAGB with PN +33^{o}2 642 supports an idea put forward by McCausland et al. (1992) (with a very small sample of stars) that possible successors of B type PAGB can be found amongst the halo CSPN.

THANK YOU