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Ne22 a primary source of neutron for the s-process and a major neutron poison in CEMP AGB stars

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In AGB stars of low mass and very low metallicity, [Fe/H]<-2, a large abundance of C12 is mixed with the envelope by each third dredge up episode. The further activation of the H burning shell at the bottom of the envelope converts almost all CNO nuclei into N14. Thus the H-burning ashes contain N14 from the original CNO nuclei, plus an increasing amount of primary N14.
During the subsequent convective thermal instability in the He shell, all N14 nuclides present in the He intershell are converted to Ne22 by double alpha capture on N14 during the early development of the thermal instability.
At the peak temperature reached at the base of the thermal pulse, the Ne22(alpha,n)Mg25 reaction is partly activated, giving rise to an efficient neutron exposure feeding the s-process. At the same time, although the neutron capture cross section of Ne22 is very small (MACS(Ne22,30Kev)=0.059+-0.0057 mbarn, Beer et al. 1991), Ne22 acts as a major poison against the s-process.
This poison effect is substantial also in case of addition of a C13-pocket with a range of neutron exposure efficiencies.
Some fraction of primary O16 is also made in the thermal pulse by alpha capture on C12 (with mass fraction X(O16) = 0.04, while X(C12) = 0.20).
Besides C12 and Ne22, a number of light isotopes are largely produced in a primary way, among which F19 (from neutron capture on O18, and other channels as well), Ne21, Na23, some Mg24, Mg25, Mg26.
An effort should be devoted to the measurement of the MACS of all the light isotopes involved with improved accuracy, in order to better constrain both the s-process efficiency and the production of light isotopes in these stars.

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