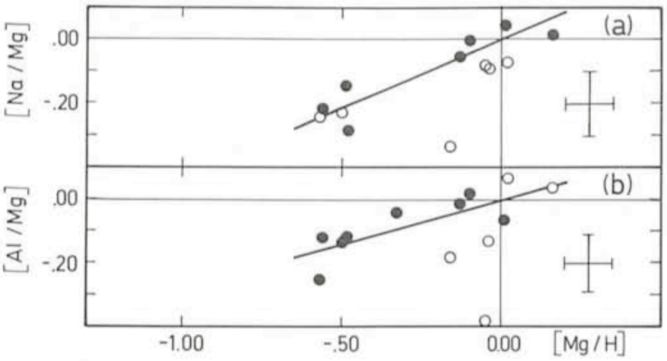

Fig. 4: *(a) Abundance ratio [Na/Mg] as a function of magnesium abundance. The error bar is calculated as in Fig. 3. Open circles denote stars where only one line of either Na or Mg was measured and for which the error bar is not defined. The line is a least squares fit to the points, required to pass through the origin. The points denoted by filled circles were given a weight of two, and those denoted by open circles a weight of one. The slope of the line is [Na/Mg] = (0.43 ± 0.08) · [Mg/H]. (b) [Al/Mg] as a function of [Mg/H]. The symbols are defined in analogy with (a). The slope of the least squares fit is [Al/Mg] = (0.28 ± 0.10) · [Mg/H]. The two panels support the prediction of Arnett (1971) and Truran and Arnett (1971) that elements with odd numbers of nucleons were less abundantly produced relative to even-numbered nuclei in metal-poor stars with low neutron excesses.*

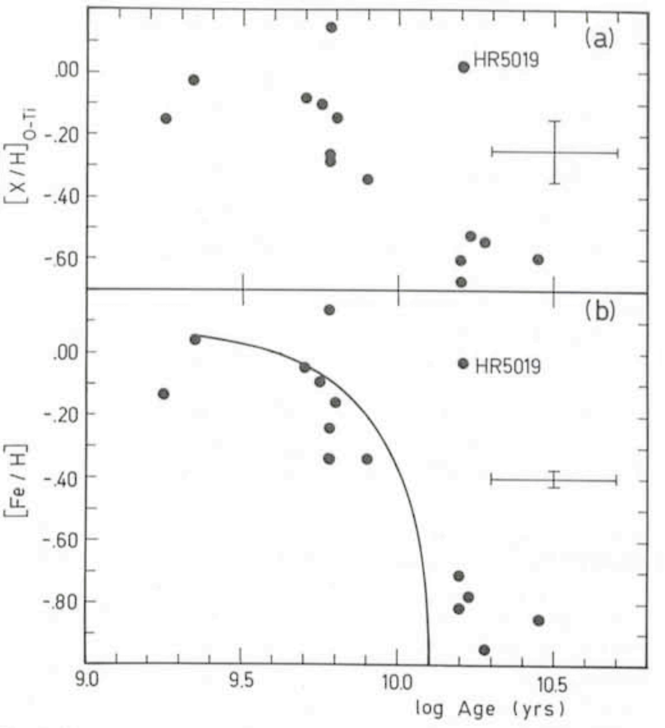

Fig. 5: *Abundances as a function of stellar age, (a) mean value of [X/H] for the "light" elements, X = O, Na, Mg, Al, Si, Ca and Ti; (b) [Fe/H] as a function of age. The curve indicates the time variation of the metal abundance in the solar neighbourhood as derived by Twarog (1980), from uvbyβ photometry of F dwarfs. The position of the star HR 5019 is also indicated.*

thereof, respectively. The slopes in Fig. 4 agree well with these calculations, if we interpolate to intermediate chemical compositions.

The heavy elements represented in the present study, Ni and Ba, seem to follow the iron abundance, with barium, determined from only one Ba II line, showing a relatively large scatter.

In Fig. 3 and 4 the origin denotes the position of the Sun. In all the diagrams it occupies a typical position for stars of similar iron abundances, indicating that the Sun is a typical star as regards its abundance pattern.

The present data are still too meagre to provide a firm basis for studying the build-up of the chemical elements as a function of age in the Galaxy. However, we have tentatively determined ages of the programme stars from the isochrones of Hejlesen (1980). The ages determined from the effective-temperature–luminosity diagrams (using the stellar trigonometric parallaxes for estimating the luminosity) are consistent within 0.2 dex with those obtained from the T_{eff} – log g diagrams (with log g determined photometrically from δc_1). The latter procedure was adopted here. We adopted a value of 2.0 pressure scale-heights for the mixing length, and a value of the hydrogen abundance by mass of X=0.70. The choice of these parameters is not important for the discussion here. We note, however, that a mixing length of 1.5 scale heights should shift the stars to lower ages by typically 0.1 dex. Such a shift would improve the agreement between the Hejlesen solar model and the Sun. The abundances of the lighter elements and the iron-peak elements are plotted as a function of stellar age in Fig. 5a. It is seen that for the present sample of stars the abundances of lighter elements, as well as that of iron and nickel can be represented by monotonic functions decreasing with stellar age. The most noteworthy exception from this is the star HR 5019 (61 Vir). Although this star has a high metal abundance, it is found to be $1.6 \cdot 10^{10}$ years old, both with the photometric method (with δc_1, as a gravity criterion) and the parallax method. It also has a relatively high space velocity, 62 km/s, for being so metal rich. However, this star is significantly cooler than the rest of our stars, and possible systematic errors in the age determinations may affect this star differently as compared with the hotter stars. The star may be worth a closer investigation. The general variation of [Fe/H] with age appears rather consistent with results derived earlier by Twarog (1980) on the basis of uvbyβ photometry for many F dwarfs, see Fig. 5b, in view of the fact that the isochrones used by Twarog were calculated with an assumed mixing length of 1.0 scale heights. When a considerable fraction of the planned sample of stars in the present investigation have been analysed, further conclusions will be possible as regards the age variation of abundances, the uniformity of abundances at any given age in the Galaxy, as well as possible tendencies for star formation to occur in bursts.

ESO Workshop on the Production and Distribution of Carbon, Nitrogen and Oxygen in Stellar Systems

A 3-day workshop to discuss observational and theoretical aspects concerning the presence of carbon, nitrogen and oxygen in stars, clusters and galaxies, will be held at ESO, Garching, 13–15 May, 1985. Contact I. J. Danziger, ESO, for more information.

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