CHEMICAL EVOLUTION OF THE GALACTIC DISK. II. GRADIENTS OF CHEMICAL COMPOSITION

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In this paper we propose a model for the chemical evolution of the solar neighbourhood and the galactic disk as well. The model takes into account the inflow of primordial gas, and the time scale associated with the process of disk formation. We follow the same physical description and formalism adopted by Chiosi (1979). However, by releasing the approximation of instantaneous recycling, we are able to describe the chemical history of the galactic disk in much better detail than in Chiosi (1979). A set of eight elements (H,D,He^3,He^4,C+O,N,n-rich, heavy) is used to describe the chemical composition of the galactic gas and inflowing material. The disk is supposed to be represented by several independent shells, whose surface mass density is thought to depend on radial distance from the galactic center and age of the galaxy. The rates of mass accretion and star formation follow the formulation of Chiosi (1979). To better approximate the results from dynamical models of disk galaxies, we have taken into account the known fact the time scale of disk formation varies with the distance from the galactic center, being of the order of 1×10^9 y in the innermost, and up to 10×10^9 y in the outermost, regions of the disk. From the body of solutions we have explored, we can derive the following results, which are shortly summarized for the case of our *best model* of chemical evolution of the disk only.

(i) The distribution of metals among G-dwarfs in the solar vicinity agrees with observational data if the time scale of disk formation at the solar neighbourhood is of the order of 4×10^9 y.

(ii) The ratio of the current to the present star formation rate as a function of the age is such that the star formation rate was at most a factor of five greater than the present value, in agreement with Mayor and Martinet (1977).

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(iii) The present gradient of metallicity, Z, across the galactic disk agrees with the observational data of Janes (1978) and Peimbert *et al.* (1978).

(iv) The gradient of the star formation rate across the disk as predicted by our model at the present epoch shows a good agreement with the data of Guilbert, *et al.* (1978).

(v) The inclusion of mass loss by stellar wind in the computation of the chemical yields per stellar generation, without changing the above results, increases the ratio $\Delta Y/\Delta Z$ (Helium-to-metals enrichment ratio over the history of the galaxy) from 0.8, which is found in the case of constant mass tellar evolution, to 3.5. The new ratio agrees very well with the observational deductions of Peimbert *et al.* (1978).

In conclusion, this model, which in a very simple way incorporates some of the fundamental results from dynamical models of the galaxy, can easily account for many of the observational constraints on the chemical structure and evolution of the galactic disk.

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