STUDIES IN GEOPHYSICS

# Material Fluxes on the Surface of the Earth

Board on Earth Sciences and Resources
Commission on Geosciences, Environment, and Resources
National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1994

# 4 Origin and Variable Composition of Present Day Riverborne Material

MICHEL MEYBECK
*Université de Paris VI*

ABSTRACT

Rivers are a major pathway in the global geochemical cycles of elements. However, little consideration has been given so far to the geographic distribution of their loads and contents because most scientists use only global figures. Actually, river chemistry is highly variable. Ionic contents are highly dependent on the lithology of the basin area; total organic carbon (TOC) and nitrogen are closely related to climate and vegetation; and total suspended solids (TSS) level and composition are linked to relief and climate. Finally, oceanic aerosols may greatly contribute to the dissolved load of surface waters. Because of these different sources, the chemical composition of water from small watersheds is extremely variable: about 15 chemical types have been reported, and most elements vary by two to four orders of magnitude. However, these ranges are only from one to three orders of magnitude for major rivers (>100,000 $km^2$). When global budgets are considered, crystalline rocks contribute to only a minor proportion of dissolved inputs to oceans. Carbonate rocks (16.3 percent of the continental surfaces) and evaporites (1.3 percent) are by far the major sources, together with soil and atmospheric $CO_2$, and oceanic aerosols.

The geographic origin of river load results from the combined influences of lithology, relief, and climate. Dissolved silica originates mainly from the humid tropics, as does total organic carbon derived from soil erosion; ions are relatively more abundant in the temperate regions due to their higher proportions of limestone; TSS originates from mountainous and dry regions found in the temperate zone, and the Huang He river alone accounts for more than 6 percent of the total river load. If the solid transport rate per unit area ($T_s$) is globally four times the dissolved transport rate ($T_d$), the ratio $T_s/T_d$ actually varies from 80 to 0.1 for major rivers, and for 40 percent of the world rivers $T_s/T_d$ is < 1. Global averages of river loads are therefore of little use in understanding the present-day pattern of element circulation and distribution, and should be considered carefully when used in geological models.