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GLOBAL CHEMICAL WEATHERING OF SURFICIAL ROCKS ESTIMATED FROM RIVER DISSOLVED LOADS

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ABSTRACT. Combination of water analyses characteristic of major rock types with their relative outcrop proportions at the surface of the continents leads to a theoretical average composition of river waters close to the actual measured value. The representative analyses are derived from a study of unpolluted monolithologic French watersheds (Meybeck, 1986), which are compared to a similar set of data from the literature for 16 major rock types from granites to evaporites. The breakdown of the river loads, corrected for cyclic oceanic salts, on a mineral basis (silicate, calcite, dolomite, gypsum, halite, sulfur minerals) and on a rock basis (plutonic, metamorphic, volcanic, shale, sandstone, carbonate rocks, evaporites) points out the minor influence of crystalline rocks on global weathering (11.6 percent of solutes from 33.9 percent of outcrop), whereas evaporites (about 1.25 percent outcrop) may contribute 17.2 percent of the dissolved river load originating from chemical denudation. Carbonate minerals found in sedimentary rocks are responsible for 50 percent of the total load derived from denudation (67 percent calcium, 42 percent magnesium). Bicarbonates are mostly derived (67 percent) from soil and atmospheric CO_2 involved in chemical denudation reactions. Major cations originating from weathering of silicate minerals are in the following proportions of total silicate weathering: calcium: 45 percent; magnesium: 20 percent; sodium: 20 percent; potassium: 15 percent (all proportions are calculated from loads in grams). Most results confirm previous apportionment attempts made by Holland (1978), Wollast and MacKenzie (1983), Berner, Lasaga, and Garrels (1983), based on the world average river composition and the field work of Stallard (ms) on the Amazon basin. If our approach is valid, the chemical erosion rates (mass of silica and major ions exported per unit area per unit time) relative to granite weathering are: granite: 1.0; gneiss and mica schist: 1.0; gabbro: 1.3; sandstone: 1.3; volcanic rocks: 1.5; shales: 2.5; serpentine and amphibolite: 5; carbonate rocks: 12; gypsum: 40; rock salt: 80.

INTRODUCTION

Following the way opened by Garrels and Mackenzie (1971), numerous geochemists have considered the global fluxes from the surface of the continents to the oceans involving the lithosphere, the atmosphere, the