# FOUR BILLION YEARS OF EVOLUTION FROM SEAWATER ISOTOPE RECORD

VEIZER, J. Institut für Geologie, Ruhr Universität, Bochum, Germany and Ottawa-Carleton Geoscience Center, University of Ottawa, Ottawa, Canada.

A new generation of 87Sr/86Sr, d18O and d13C curves for Precambrian and Phanerozoic seawater, based on several thousand stratigraphically well defined and well preserved samples, results in much better constrained secular trends. All first order isotope trends over billions of years, including d34S but not d18O, can be generated by a model driven by two variables, exponential decline of mantle heat dissipation combined with a delayed growth of continental crust. This scenario generates also oxygenation of the ocean/atmosphere system around the Archean/Proterozoic transition without resorting to a need for biological innovation.For the Phanerozoic, the oxygen isotope signal exhibits a long-term increase of d18O from a mean value of about - 8 ‰ (PDB) in the Cambrian to a present mean value of about 0 ‰ (PDB). Superimposed on the general trend are shorter term oscillations with their apexes coincident with cold episodes and glaciations. The carbon isotope signal shows a similar climb during the Paleozoic, an inflexion in the Permian, followed by an abrupt drop and subsequent fluctuations around the modern value. The means of the observed isotope signals for 87Sr/86Sr, d18O, d13C and the less complete d34S (sulfate) are strongly interrelated at any geologically reasonable (1 to 40Ma) time resolution. Factor analysis indicates that the system is driven by three factors. On geological timescales (more than 1 Ma), we are dealing with a unified exogenic (litho-, hydro-, atmo-, biosphere) system driven by tectonics via its control of (bio)geochemical cycles.