OPEN ACCESS Freely available online

Journal of Geology & Geophysics

Commentary

Rates of Geological Processes

Malcolm Hart*

Department of Geology, University of Plymouth, United Kingdom

DESCRIPTION

Geologic processes occur at a variety of speeds, from imperceptibly slow to extremely fast. Similarly, the rate at which the earth's crust recovers after continental glaciers retreat is typically a few millimetres per year and diminishes with time. Geological processes are phenomena that happen over millions of years, hundreds of metres, or thousands of kilometres in geological time. Compare this to daily physics and engineering simulations that are run on laboratory scales and on the scale of a human lifetime. In the geological sciences, rates are frequently used to describe processes, and the ratios that rates represent demand additional study. The numerator is a measure of difference or change, while the denominator is usually a time interval. The quantitative relationship between differences and rates and their corresponding time intervals is known as temporal scaling. These are proportional relationships that should be explored on logarithmic axes. Here log-difference-interval (LDI) and log-rate-interval (LRI) graphs are analyzed for nine empirical case studies involving creep on the San Andreas Fault, anthropogenic carbon emissions, glacial advance and retreat, sediment accumulation, tectonic uplift and exhumation, river incision, beryllium-10 dating of outcrop and basin erosion, climate-related temperature change, and species-level extinction. Fault creep and carbon emissions are two studies that are directional in the sense that they both observed differences evolving in proportion to their related time intervals; as a result, estimated rates are independent of their denominators. The remaining studies are random or stationary, with rates that are reliant on their denominators and differences that are independent to some degree from their related intervals. Because observed changes or differences are generally confined to a very narrow range compared to the considerably longer time spans over which geological rates are estimated, rates based on denominators are common in geological investigations. Any comparison of the rates involved must be constrained to, or projected to, some common denominator or common scale of time when LDI or LRI temporal scaling reveals change to fit a random or stationary model, meaning rates are dependent on their denominators. Radionuclide calibration of outcrop and basin erosion, as well as biological extinction, are two stationary processes with rates that are frequently compared on separate time periods, which is incorrect. Geologic processes occur over a range of time scales. Introductory geology courses should provide students with an understanding of earth processes as well as the rates at which these processes operate. Three quantitative problems involving the rate of radioactive decay, the movement of groundwater pollution, and the rate of erosion in the Himalayas are described. These problems require students to graph data, understand units and orders of magnitude, manipulate equations, and put numerical answers into a broader geologic context.

Correspondence to: Malcolm Hart, Department of Geology, University of Plymouth, United Kingdom, E-mail: Hart Malcolm@.ac.uk

Received: June 09, 2021; **Accepted**: June 23, 2021; **Published**: June 30, 2021

Citation: Hart M (2021) Rates of Geological Processes. J Geol Geophys. S3:002.