

## a18 Classification of geological processes < physical geology >



To reach a decision, [Colombia's] Kogi [Indian] leaders drop beads into round bowls of water. Patterns of air bubbling out reveal whether to eliminate an option in an array of decisions. In working with the Kogi, planners from industrialized societies who can't shed hard-driving, goal-oriented ways may find their sanity bubbling away as well. —Susan Milius, 1998.<sup>1</sup>

Few exemplars of how to do geology existed when **George Bellas Greenough**<sup>2</sup> (1778-1855) a student of Werner began his field work in England. Yet shy of thirty he became, as chief instigator the inaugural president of the Geological Society of London (founded in 1807) and *eminence grise* (*French*: refers to the grey cloak of Cardinal Richelieu) behind the development of inductive geology. This was the first learned society in the world to be devoted to a specific science and to allow for discussion following upon the reading of a paper (but *in camera* in obeisance to notion that science dealt only with dry facts and that publicly aired debate would but send the wrong message and so endanger a society's prestige). Geotheories spun by savants as de Luc and Hutton he judged wanting as deductions from these produce geohistories far too broad to account for the diversity of geological detail of immediate interest to mineral prospectors and miners. However, geologizing using Baconian induction can produce detailed geohistories of locals. This had been done in France for the extinct volcanoes and associated basalt lava flows in Auvergne by Nicolas Desmarest (1725-1815) and in Vivarais by Jean-Louis Giraud-Soulavie (1752-1813). Both workers had investigated traces of the past in order of increasing age evidenced by field observations *before* reversing tack to tell of the discovered epochs as geohistories. Of value, Saussure in 1796 published his *Agenda* for Earth sciences.<sup>3</sup> In this, the methodological and heuristic order of presentation is: from the clearer to the more obscure, from the relatively recent into the deeper past. Also, in a precise accounting of which fossils occur in each formation is recommended to reveal "the relative ages and epochs of appearance of different species."<sup>4</sup> Circa 1815,<sup>5</sup> John Farey advised Greenough to abandon Wernerian principles and to adopt Smith's classification of the strata (ordered by faunal succession) and method revealed in Smith's geological map made available in prepublication form for the private use of members of the Geological Society of London.<sup>6</sup> By 1819, Greenough could write of Werner: "His theory was useful as a standard of reference, an incitement to inquiry, a clue to observation; but, unfortunately for Werner, his pupils viewed it in a different light."<sup>7</sup>

Today, the rock cycle gives us an organizational framework for the classification of geological processes & products and is the standard way in which topics are sequenced in physical geology textbooks. In *Principles of Physical Geology*, 1944, Arthur Holmes (1890-1965) summarized:<sup>8</sup>

### I. PROCESSES OF EXTERNAL ORIGIN

1. Denudation (Weathering, Erosion, and Transport): Sculpturing of the land surface and removal of the products of rock decay mechanically and in solution.
2. Deposition
  - (a) of the debris transported mechanically (e.g. sand and mud).
  - (b) of the materials transported in solution:
    - (i) by evaporation and chemical precipitation (e.g. rock salt).
    - (ii) by the intervention of living organisms (e.g. coral limestone).
  - (c) of organic matter, largely the remains of vegetation (e.g. peat).

### II. PROCESSES OF INTERNAL ORIGIN

1. Earth Movements (including earthquakes): Uplift and depression of land areas and sea floors; and mountain building by lateral compression (folding and overthrusting) of rocks.
2. Igneous Activity: The intrusion of magmas and the extrusion of lavas and other volcanic products.
3. Metamorphism: The transformation of pre-existing rocks into new types by the action of heat, pressure, stress, and chemically active migrating fluids.

Geohistories now recount the workings & products of the rock cycle in past places and epochs. □