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Variable radius cartography – History and perspectives of a new discipline

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The map that Toscanelli sent to Columbus was an unconscious application of cartography at a smaller radius than the real. The first really conscious attempts to represent the geography of Earth on globes of radius less than the current one occurred after the formulation of the concept of expanding Earth through geological time.

The American chemist and geologist Richard Owen (1810-1890) in his book *Key to the geology of the globe* (1857) described the principles of what he himself called *Anatomical Geology*, with the Earth growing as a biological organism. The book contained a global paleogeographic map of the Earth that would have had a radius of about 4000 kilometers. In 1928 J.A.H. Kerkhoff (under the pseudonym *Aero-dilettant*) published a series of paleogeographic globes on which the modern oceans disappeared. With the same artisan methods of transfer continental outlines from a sphere to a smaller one, in 1933 O.C. Hilgenberg represented three different geological epochs, and, later, for the first time mapped paleopoles with their site-pole segments of meridian. Even today the traditional method of Hilgenberg is followed by senior researchers (Klaus Vogel, 2003) and younger geologists (James Maxlow). In England Hugh Owen applied the methods of traditional cartography to the variable radius one. His *Atlas of Continental Displacement* was in the 70s and 80s, for this discipline, a real milestone.

While in the field of constant radius paleogeography the adherents to plate tectonics created many computer codes of automatic mapping (Bullard et al., 1965; Smith & Hallam, 1970; Scotese et al., 1979; and many others), in the variable radius field few tried to reach the same task. In 1972 in United States a first very simple attempt (but was not further developed) came from a private, R.B. Perry, followed by the still not-computerized *Atlas* of Owen, and both them constituted inspiration for the construction of a FORTRAN variable radius mapping code at INGV, with which it is now possible to represent paleopoles, their uncertainty ellipses, and site-pole segments of meridian (Scalera, 1988, 1990).

In all paleogeographic reconstructions of the different authors, variable radius cartography is used in a way more or less complex, more or less intertwined with other disciplines and databases, not as pure representation or in the spirit of the simple *fits* that supported plate tectonics, but as experiments of greater complexity with a value of proof in favor of the planet expansion. Today a common feeling is that is now necessary to develop an interactive and *user friendly* program code, which could be distributed or used in the web. The use of variable radius mapping would be a profitable tool in the field of geodesy, where a full treatment without subtle vicious loops of an expanding globe has yet to be developed.