

Fractal geometry of continental sedimentary basins

Leonov M.G.

Geological Institute of the Russian Academy of Sciences, Moscow, Russia

e-mail: mgleonov@yandex.ru

The geometry of objects occupies one of the main places in the natural processes models [2, 4]. In 1982 Benoit Mandelbrot [6] introduced the concept of fractal geometry. A strict definition of fractals does not exist. Mandelbrot proposed to use the simplest definition: «fractal is a structure consisting of parts that are in some sense similar to the whole» (cited by [3]). This report deals with the fractal geometry of natural sedimentation basins (OB). Study of Onega, Orsha, Michigan basin, also depressions of the Tien Shan, Sunda shelf, Pre-Caucasian trough, El-Reef) revealed the fundamental property of OB – the differentiation of primary fosses into a system of secondary anticlinal (elevation) and synclinal (deflections) linear morphostructures. The intermittency of uplifts and troughs is spatially ordered: the axial planes of first-order structures are arranged in increments of 150–250 km, the axial planes of second-order structures have a step of 15–25 to 30–50 km. There are structures of higher orders. Thus, in many regions, the basement is represented by tectonically granular granites, the infrastructure of which is represented by diamond-shaped cells of mega-, macro-, meso- and micro-scales.

Multi-order basin structures have a similar structure, orderliness of spatial arrangement and geometric pattern [1]. In other words, they are self-similar. Self-similar is a characteristic property of fractals [3] and indicates the fractal nature of the internal structural divisibility of sedimentary basins. This position is confirmed by the existence of structures similar to the so-called viscous fingers, which have a fractal nature [7]. The concept was introduced [5] to refer to the process of displacing a more viscous liquid less viscous in a granular medium and is widely used, in particular, in petroleum geology. The behavior of matter is considered in this case within the framework of the laws of hydrodynamics. These data show: (1) the multi-scale structural forms of OB are self-similar, which makes the assumption of their fractal nature legitimate; (2) the presence of structural-kinematic features of the reid flow in the basement rocks and the formation of structures such as viscous fingers allows consideration of the behavior of «solid»; crystalline rocks as objects hydrodynamic.

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