



Knowledge Engineering Approach to the Geotectonic Discourse

Cyril Pshenichny

Geognosis Project, Intellectual Systems Laboratory, ITMO, St. Petersburg, Russian Federation (cpshenichny@yandex.ru)

The intellectual challenge of geotectonics is, and always was, much harder than that of most of the sciences: geotectonics has to say much when there is objectively not too much to say. As the target of study (the genesis of regional and planetary geological structures) is vast and multidisciplinary and is more or less generic for many geological disciplines, its more or less complete description is practically inachievable. Hence, the normal pathway of natural-scientific research – first acquire data, then draw conclusion – unlikely can be the case here. Geotectonics does quite the opposite; its approach is purely abductive: first to suggest a conceptualization (hypothesis) based on some external grounds (either general planetary/cosmic/philosophic/religious considerations, or based on experience gained from research of other structures/regions/planets) and then to acquire data that either support or refute it. In fact, geotectonics defines the context for data acquisition, and hence, the paradigm for the entire body of geology.

Being an obvious necessity for a descriptive science, this nevertheless creates a number of threats:

- Like any people, scientists like simplicity and unity, and therefore a single geotectonic hypothesis may seem preferable once based on the data available at the moment and oppress other views which may acquire evidence in the future;
- As impartial data acquisition is rather a myth than reality even in most of the natural sciences, in a study like geology this process becomes strongly biased by the reigning hypothesis and controlled to supply only supportive evidence;
- It becomes collectively agreed that any, or great many, domains of geological knowledge are determined by a geotectonic concept, which is, in turn, offered by a reigning hypothesis (sometimes reclassified as theory) – e.g., exploration geologists must involve the global geotectonic terminology in their technical reports on assessment of mineral or hydrocarbon resources, sessions and conferences are entitled like “Geochemical signatures of postcollisional magmas” thus assuming that the concept of collision (i) has been proven to reflect the reality and (ii) surely has something to do with geochemistry of rocks; tectonic terminology becomes a ubiquitous language with no warranty of its correctness and appropriateness to the case.

These issues fall into the scope of the field defined as reasoning research in the geosciences (Pshenichny, 2002; 2003). One of its main tools is knowledge engineering (Feigenbaum, 1984). As has been suggested by Anokhin and Longhinos (2013), knowledge engineering, especially its dynamic part being rapidly evolving now, may offer remedies to handle the abovementioned problems. The following solutions will be reported:

- Development of an integrated geotectonic context and language shared by the community that follow contrasting geotectonic views; making concepts more or less inter-hypothesis; studying the “anatomy and physiology” of geotectonic hypotheses and fixing the points of concordance, compatibility and disagreement, computation of logical probabilities of the views given a number of hypotheses (Pshenichny, 2004);
 - Constructing the ontologies, conceptual graphs and event bushes for data acquisition to impartially define the semantics of data and data provenance in geology;
 - Building the ensembles of event bushes for related domains of geological knowledge (petrology, volcanology, sedimentology and others) to track the actual influence of geotectonic concepts and views on the geo-knowledge.
- Following these lines of research would create a better environment for flourishing of scientific thought in geology and makes it more efficient and operative in responding to its traditional tasks (impartial geological mapping, mineral and hydrocarbon exploration, geological education and knowledge transfer) and challenges of nowadays such as natural hazard assessment, sustainable regional development, and so forth. Moreover, this would make a significant contribution to creation of a knowledge-based society that is seen as one of the key priorities of Europe and the civilization in general.