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Regional hydrogeofomatics as a sensitive tool for defining strain-stress conditions during oil and gas exploratory works

G S Vartanyan and E A Zaltsberg
LSK Inc. Toronto Canada

Geodynamic processes could negatively influence development of oil and gas fields' exploration by destructing technological processes and well constructions, transportation systems and other infrastructures. In particular, such destruction could result in lost of well construction integrity resulted in hydrocarbon fuel blows. In addition, significant and even irreparable damage could be made to the environment. Due to lack of tools for timely defining dangerous geodynamic developments, such damages are usually unexpected and very often accompanied by tremendous human and financial losses. During the last 30-35 years the methodology of regional hydrogeodeformatics as well as principles of hydrogeodeformation (HGD) field monitoring were tested and developed [Vartanyan, 1979, 1998, 2001, 2006, 2010, 2013,; Vartanyan, Bredehoeft, Roelloffs, 1991; Vartanyan, Christensen, Gosk, Tsukuda, 2002; Vartanyan, Stajilo-Alekseev, Zaltsberg, 2013]. They are based on the discovery of the new kind of the geophysical field of the Earth – the HydroGeoDeformation field (the Vartanyan-Kulikov hydrogeological effect – Vartanyan G.S., Kulikov G.V., 1982; Discoveries and Inventions, 1983). Special parameters characterizing stress-strain conditions within geological massifs have been developed which allow monitoring changes in these conditions at any time scale (hourly, daily, monthly, etc.). These parameters could also be used for monitoring the areal changes in deformation conditions within the huge geological regions. Therefore, the HGD monitoring provides valuable information on the areas and timing of the potential dangerous geodynamic process occurrences. The paper contains the results of HGD monitoring conducted in various regions of the Earth which allowed making predictions of potentially dangerous geodynamic conditions threatening the safety of infrastructures and personnel within the huge regions. Based on the existing experience, some practical recommendations regarding establishing HGD monitoring system and interpretations of its results are given. Their implementation would be of help in making timely strategic decisions which in many cases could prevent catastrophic consequences of dangerous geodynamic development at main oil and gas fields and transportation systems.

Biography

Vartanyan Genrikh, Dr. Sci., PhD (geology), Professor, Member of Russian Academy of Natural Sciences, Director of the Russian National Institute for Hydrogeology and Engineering Geology (1983 -2003), Vice-President of LSK. Inc. Vartanyan is one of the leading specialists in the areas of hydroseismology and geodynamics. He established and developed the new branch of modern geology namely regional hydrogeodeformatics. This discipline deals with the newly discovered hydrogeodeformation field of the Earth (the Vartanyan-Koulikov hydrogeological effect) and allows defining fast changes in the stress-strain conditions which could cause earthquakes. Based on the principles and methodology of this new discipline, specialized hydrogeodeformation monitoring network has been established in several countries. The monitoring results obtained are widely used for predicting dangerous changes in geodynamic conditions within the huge seismically active regions.

gayanav@hotmail.com

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