POSTER

EVALUATION OF GEOLOGIC HAZARDS FOR THE TRANS-CAUCASUS CASPIAN OIL AND GAS PIPELINES IN THE ABUL-SAMSARI VOLCANIC RIDGE SECTION

Okrostsvaridze, A.[1], Bluashvili, D. [4], Boichenko, G.[2], and Gogoladze, S.[3]
[1,2,3] Faculty of Natural Sciences and Engineering and Institute of Earth Sciences of the Ilia State University, 0162 Tbilisi, Georgia;
[1] *avtandil.okrostsvaridze@iliauni.edu.ge;* [2]*giorgi.boichenko@iliauni.edu.ge;*
[3]*salome.gogoladze.2@iliauni.edu.ge*
[4]Faculty of Geology and Mining of the Georgian Technical University, 0179 Tbilisi, Georgia
[4]datoblu@yahoo.com

Keywords: ***Caspian oil and gas pipelines, Georgia, seismic and volcanic hazards***

Introduction

The Caspian region has the potential to become one of the major oil and gas producing areas in the world. The Republic of Georgia, situated in the central part of the Caucasian region, provides a natural pipeline corridor from the Caspian region to the west. The Baku-Supsa (BS) and the Baku-Tbilisi-Ceyhan (BTC) oil pipelines, as well as the Baku-Tbilisi-Erzurum South Caucasian natural gas pipeline (SCP) traverse this corridor through Georgia (Fig. 1). The BTC and SCP were designed to withstand volcano-seismic events of the Quaternary Abul-Samsari volcanic ridge.

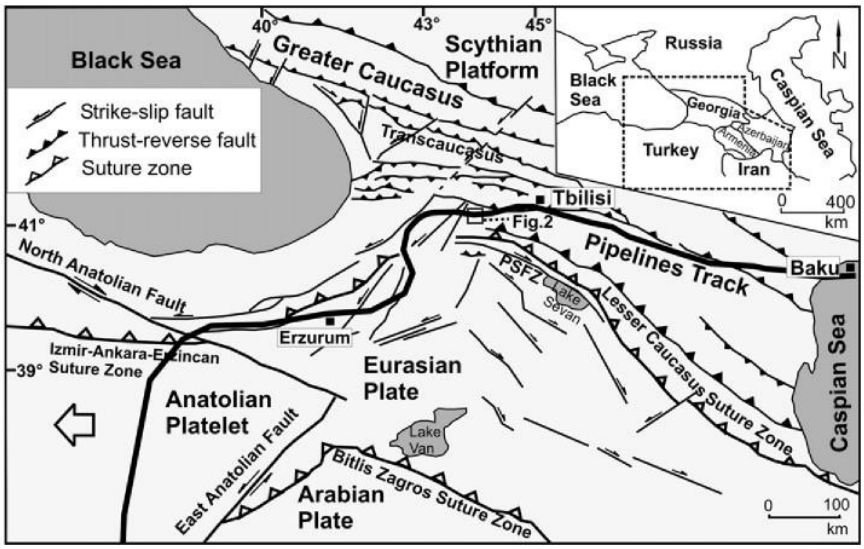

Figure 1. Geodynamic framework of the Caucasian region with indication of the BTC and SCP pipeline tracks. PSFZ = Pambak-Sevan Fault Zone Adapted after Koçyigit et al. 2001. The study area is indicated by a square.

The studied area

Tavkvetili and Shavnabada volcanoes at the northernmost edge of the Abul-Samsari Ridge, extremely close to the pipeline corridor (Fig. 2); studies of these volcanoes have a long history (Skhirtladze, 1958). Tavkvetili volcano is a scoria cone, up to 2582 m in elevation, with a well-preserved summit crater 200 m in diameter. Several lava flows outpoured from the vent and flowed northward and southward 4 km away.(see Fig. 2). Tavkvetili dacite is aphyric with a glassy black groundmass; the

lava flows are a few decimeters to meters thick. These textural characteristics suggest that this lava had a low viscosity during emplacement. Shavnabada volcano is located 6 km south of Tavkvetili and shows two vents (see Fig. 2). The northern vent has produced a scoria cone up 2929 m in elevation. The southern vent is a small shield cone with a distinguishable summit crater and radial lava flow field. Shavnabada andesite is also aphyric with a glassy black groundmass. Tavkvetili and Shavnabada are among the youngest volcanoes of the Abul-Samsari Ridge (Okrostsvaridze et al., 2016). Also, our geomorphologic observations indicate the absence of periglacial activity on the slopes, and well-preserved summit craters suggest that volcanic activity probably postdates the last glacial retreat (<10,000 BP).

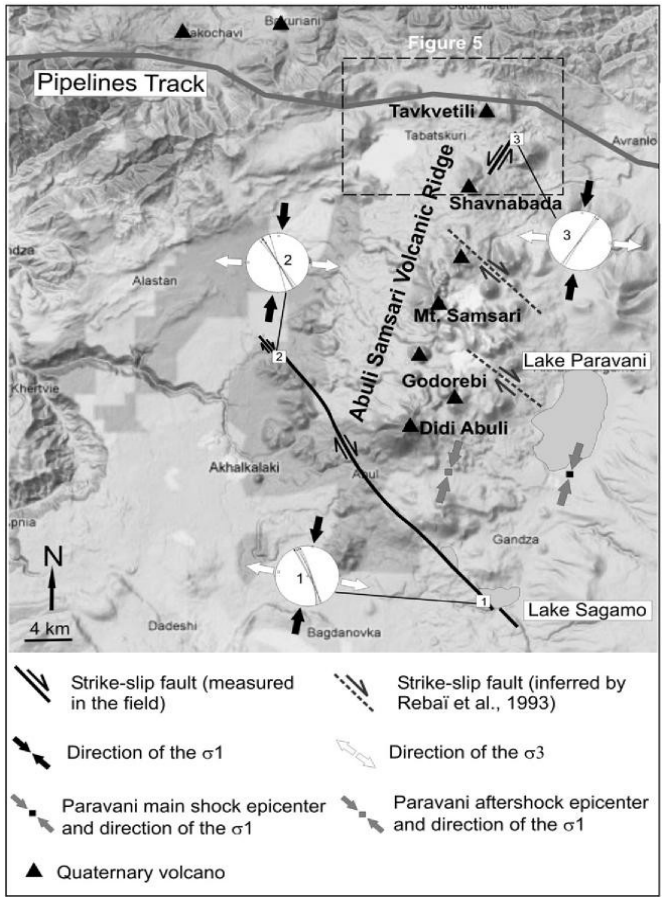

Figure 2. Map of the Abul-Samsari Ridge showing fault plane stereograms along the main faults with indication of the related stress regime. Left-lateral strike-slip faults, N-S to NNW-trending normal faults associated with late Pleistocene-Holocene volcanoes (Pasquarè et al., 2011).

The results

As a result of our analysis, the Baku-Tbilisi-Ceyhan (BTC) oil pipeline, as well as the Baku-Tbilisi-Erzurum South Caucasian natural gas pipeline (SCP) were designed in such a way that they significantly reduce the risk posed by the newly-identified geohazards. However, since the consequences of long-term shut-down would be very damaging to the economies of western Europe, we conclude that the regionally significant BTC and SCP warrant greater protections, described in the final section of our work. The overall objective of our effort is to present the results in a matrix framework that allows the technical information to be used further in the decision-making process, with the goal of reducing any uncertainty for the final decision.

Discussion

Based on the results of our structural study, we believe the approximately N-S directed σ1 has major implications for volcanic reactivation, which might occur in the form of fissural eruptions and successive growth of localized vents along an about N-S tectonically-controlled direction. Since the pipeline right ide of the way is immediately north of Tavkvetili Volcano, there could be increased volcanic risk that was not addressed in the initial design.

This work is making it possibile to identify and quantify geologic hazards threatening the strategic Caspian oil and gas pipelines through the Republic of Georgia, in the vicinity of the Middle-Late Pleistocene-Holocene Abul-Samsari Volcanic Ridge. As regards seismic hazards, we identified a major NW-SE trending strike-slip fault; based on the analysis of fault planes along this major transcurrent structure, and approximately N-S trend of the maximum horizontal compressive stress. σ1 was determined, which is in a good agreement with data instrumentally derived after the 1986, M 5.6 Paravani earthquake and its aftershock. The strong alignment of volcanic vents along the N-S trend is particularly notable and suggests a magma rising controlled by the N-S directed σ1 (see Fig. 2).

Conclusion

The conclusion of the analysis is that the BTC and SCP were designed in such a way that risks posed by the newly-identified geohazards in the vicinity of the Abul-Samsari Ridge were reduced significantly. No new measures are recommended for the pipeline itself as a result of this study. The regionally significant BTC and SCP may warrant greater protections, since the consequences of longterm shut-down in the event of a lava flow or large landslide engulfing the valve station would be very damaging to the economies of western Europe. The additional protections recommended in this case would include an upgrading of the road system that leads to the pipeline service roads, in order to allow delivery of construction equipment and materials. This upgrade could happen in the near future, or be considered part of the overall response action after a volcanic or seismic event leads to a loss of this section of the pipeline.

Finally, the risk communication in this paper has not been applied to volcanic and seismic risk assessments. We believe that the risks, damages, and costs should be framed in a quantitative way, then simplified displays such as those provided here should be considered for a meaningful discussion about mitigation measures and to provide firm support for decisions. Moreover, we think the proposed methodology has wide applications, beyond the geographical area we have addressed in our research.

References

Koçyiğgit, A., Yılmaz, A., Adamia, S., and Kuloshvili, S. 2001. Neotectonics of East Anatolian Plateau (Turkey) and Lesser Caucasus: Implication for transition thrusting to strike-slip faulting. *Geodinamica Acta* 14(1–3): 177–-195.

Okrostsvaridze, A., Popkhadze, N., Bluashvili, D., Chang, Y. H., and Skhirtladze, I., 2016. Pliocene-Quaternary Samtskhe-Javakheti Volcanic Highland, Lesser Caucasus as a result of mantle plumes activity. Gilbert, A.S., and Yanko-Hombach, Valentina, eds., *Proceedings of the Fourth Plenary Conference of IGCP 610 "From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary" (October 2-9, 2016; Tbilisi, Georgia),* Georgian National Academy of Sciences, Tbilisi, pp. 127–-131.

Pasquarèe, F.A., Tormaey, D., Vezzoli, L., Okrostsvaridze, A., and Tutberidze, B., 2011. Mitigating the consequences of extreme events on strategic facilites: Evaluation of volcanic and seismic risk affecting the Caspian oil and gas pipelines in the Republic of Georgia. *Journal of Environmental Management* 92(7): 1774–-1782.

Skhirtladze, N. I., 1958. Postpaleogenovyj effuzivnyj vulkanizm Gruzii [Post-Paleogene Effusive Volcanism of Georgia]. Tbilisi, Akademiâ Nauk Gruzinskoj SSR (In Russian).