Application of lithogeochemistry for regional scale mapping of geothermal prospectivity in Sabalan volcano, North West of Iran

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Many different techniques are suggested for geothermal (convective systems) exploration including geological mapping, magnetic, gravity, hot spring, geochemical sampling, seismic and well logging methods. Geothermal systems are usually characterized by indicative geological features that may not be implied or easily be described by only one analytical method. The methodology presented here provides combined applications of several different methods in order to generate regional scale mapping of geothermal prospectivity in Sabalan volcano located in North West of Iran. The relation of the geothermal occurrences (18 geothermal occurrences used as training points) to evidential maps is assessed by means of the logistic regression as a data driven method. Six evidential maps were used derived from maps of (1) gravity, (2) magnetic, (3) geology, (4) zone proximal to hydrothermal alteration, (5) zones proximal to faults, (6) geochemical multiplicative zonality (V_z). The first five evidential maps are selected based on previous research works. Sixed evidential map is selected based on geochemical zonality anomaly.

According to geochemical studies As, Sb, Hg, Bi and B are typically enriched in geothermal areas. Thus V_z can be introduced as a geochemical evidential map for geothermal exploration.

At least seven sub-areas (in which two areas have been explored and exploited) can be recommended for follow up exploration work based on favorability map. The results indicated that, integration of V_z evidential map with other maps used as spatial evidence is important in filtering-out false selected areas.

[1] Carranze, E.J.M., Wibowo, H., Barritt, S.D. and Sumintadireja, P. (2008) Spatial data analysis and integration for regional-scale geothermal potential mapping, West Java, Indonesia, *Geothermics*, pp.267-299.

Geochemistry of mantle microxenoliths from Zagadochnaya kimberlite (Yakutia, Russia)

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The Zagadochnaya kimberlite is a barren type-II kimberlite, which contains Cr-diopside, pyrope garnet (Grt) and spinel xenocrysts, as well as eclogite and grospydite xenoliths [1], but no discrete peridotite xenoliths. We have investigated Grt grains and associated minerals. Some Grts (groups A, B) and associated Cr-diopsides (similar to subgroups IIa, IIb of [2]) show evidence of an early metasomatic event and variations in LHREE/HREE ratios compatible with a model of percolative fractional crystallization of kimberlite melts [3]. Other Grts (group C) exhibit strongly sinusoidal CI-normalized REE patterns, typical for cratonic Grt-peridotites produced by metasomatism of strongly refractory harzburgites. Most of group B and C Grts show secondary domains rich in Cr-diopside + Cr-spinel ± phlogopite. In these domains the Grts are (Ca, Cr)-depleted, are enriched in almost all incompatible elements, and show humped CI-normalized REE patterns (max at Eu). Low Ti/Zr ratios (~ 10) and presence of phlogopite in these domains suggest an origin by reaction with a melt of type-II kimberlite affinity. Based on Ca concentration profiles across Grt zoning, this late-stage event took place less than 10^4 years before the Zagadochnaya kimberlite eruption, i.e. it was probably related to the same magmatic stage of the host kimberlite.

[1] Sobolev *et al*. (1968) *J Petrol* **9**, 253-280. [2] Nimis *et al*. (2009) *Lithos* **112**, 397-412. [3] Burgess & Harte (2004) *J Petrol* **45**, 609-634.