Contribution ID: **66** Type: **POSTER**

DETERMINATION OF URANIUM-BEARING SAMPLES IN TERMS OF POSSIBLE CONTAMINATION, ARIKLI URANIUM REGION, CANAKKALE, TURKEY

Wednesday, 27 June 2018 17:00 (1 hour)

INTRODUCTION

Radioactive mineralisation sites and related exploration activities threaten the living ecosystems of surround

Radioisotope distribution continuously vary among landscape components (e.g. rock, soil, groundwater and surfa

Sampling strategy is one of the most important issues in contamination research. Methods which are suitable for one environment may be quite inappropriate for another one. For example, the mechanisms of the formation of uranium deposits vary widely and hence the geochemical makeup of the deposits also vary [3]. Therefore, careful measurements and analyses are needed to understand the geological and physical structure of the area before cost-effective analyses.

Generally, for the determination of the radioactive element distribution originating from an exploration site, the easiest and cheapest step is to carry out outdoor absorbed gamma dose measurements (OAGD). The distance between the measurement points should be adjusted according to the detector range and integration time. Based on the gamma measurement values, the target area can be restricted. Especially, if erosion is dominant in the area, drawing the borders along the hilltops, gives the advantage to understand the flow of elements.

Primarily the catchments of the exploration sites should be investigated, but measurements should also be performed at neighbouring catchments in terms of comparisons of the results and possible contamination risk.

For sampling design, the next step is geochemical analysis. Geochemical parameters such as pH, EC (electric con

Proper GIS operations using all the multisource predictor maps such as lithology, topography, soil type, land c

The case study reported in the present work develops an integrated methodology including geochemical, radiometric and GIS-based landscape analysis for the determination of uranium-bearing samples to assess the possible uranium-related contamination at Arıklı uranium mineralisation region.

DESCRIPTION

The restricted study area, after the OAGDR orientation measurements, is covering Arıklı (Turkey/Çanakkale/Ayva

According to the geochemical analyses applied to the samples taken from rock dumps and exploration ditches,

By the help of the phosphate related studies on Arıklı tuffs

(ignimbrite) performed by Çelik et al. (1999), Günaydın and Çolak (2009) and Günaydın (2017) it was concluded that uranium and phosphate enrichments were formed by the help of hydrothermal fluids and they were accumulated at fragmented fault zones [15,16,11]. Bayleyite [Mg2(UO2)(CO3)3.18H2O] and ningyoite

[(U,Ca,Ce)2(PO4)2.1–2H2O] were defined as minerals of uranium in the area. During the studies, 1:5000 scale geological maps were prepared [11].

Based on the restrictions after outdoor gamma measurements, the final study area covers approximately 12 km2 at

The study area consists of four main rock groups. These are Upper Cretaceous aged ophiolitic base rocks, vo

MATERIALS AND METHODS

Taking into consideration the studies made by MTA, at first OAGDR (Outdoor Absorbed Gamma Dose Rate) orientation measurements were performed in the presented survey covering Arıklı, Nusratlı, Ahmetçe, Hüseyinfakı, Demirciköy and Kayalar villages, approximately 50 km2. For the measurements, portable ESP-2 Na(I) probed Eberline gamma detector was used at 1 m above the ground level during 100 s for each measurement [22]. The measurements were planned according to the lithological units. The map of the OAGDR data was prepared by kriging geostatistical interpolation method applying with the Arc-GIS software. As a result, the study area was restricted into a 2,63 x 4,25 km rectangle (˜11 km2) which includes the catchment area of Arıklı mineralisation site and the Arıklı village.
The restricted area first was split into 500x500m grids then inside the catchment, they were minimised to 250x250m. From the corners of each square, OAGDR measurements were taken. Open exploration ditches were identified and their OAGDR measurements were taken, either.

From the measurement points soil samples were collected. Before collecting the soil samples, the sampling point

For pH measurement 6 g sample was mixed with 15 mL distilled water and after 12 h waiting, measurements were

For carbonate analysis, 3–10 g soil was mixed with 0.1 M HCL solution. The probe of the Scheibler calcimet

Barium chlorite method was used for cation exchange capacity analysis (CEC). 4 g sample was mixed 0.1 M BaCl2 solution and buffered up to pH 8.0 with tetraethyl ammonium (TEA). After stirring by shaker 2 hours at 480 rpm the solution was filtered into centrifuge tubes and centrifuged. Finally, Ba2+ content is measured by ICP-OES [25].

On account of topographic analyses, run-off, slope-break and watershed models were derived from Digital Elevation Model (DEM) for 5x5m grid cells (Jordan, 2011). Drainage map and land cover map derived from topographic map using Arc-GIS software. All the multisource predictor maps were superimposed by using GIS operations using Surfer Software Homogeneity test of univariate distributions, bivariate scatter plots, and multivariate cluster analysis (CA) and, principal component analysis (PCA) were used for statistical analysis.

RESULTS

In the area, the highest outdoor gamma levels were detected at Karakisla region. In the study area, other anomal

Since the area was under the effect of slope driven soil erosion, the OAGDR measurements were more correlating with topographical units than with the lithological units. The gamma levels at the alluvial accumulating flat bottoms of valleys were also higher than the background level due to the erosion effect and hills acted as physical barriers to prevent the dispersion of the radioactive contaminants from the catchment.

According to the results of soil chemical analyses, higher values of EC and CEC measurements were driven by topographical and hydrologic barriers. For example, in the alluvial accumulative bottoms of valleys and along the meanders of stream branches, where water flow is slower, deposition took place providing higher values of EC and CEC. Regarding pH and carbonate measurements, their results correlated to each other and had the highest values in the beach sample.

CONCLUSION

Although there are numerous in situ geogenic radioactivity determination studies, this interdisciplinary developed methodology helps to analyse the behaviour of uranium distribution originating from Arıklı mineralisation site. It determines the geochemical, topographic units and proves their control mechanisms on the distribution.

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Session Classification: Poster Session

Track Classification: Track 4. Advances in exploration