GIS and statistical techniques to evaluate stream sediments and pan concentrate from Peshawar Basin, Pakistan

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Abstract

The utility of GIS techniques are widely employed by geologists for storing, processing and visualizing geochemical data. These techniques together with statistical methods, involving univariate, bivariate and multivariate statistical analysis, play a key role in the field of exploration geochemistry and make the task very easy, thereby, analyzing huge data sets in very short time. The methods were applied to regional geochemical data of Peshawar basin (districts Swabi, Mardan, Nowshera, Charsadda and Peshawar). Samples were collected from stream sediments, panned concentrate and Quaternary deposits. A total number of 92 pan concentrate and 272 stream sediments were analyzed for Au and Ag and base metals such as Cu, Pb, Zn, Ni, Cr, Co and Cd using graphite furnace atomic absorption spectrometer (modal AAS-PEA 700).

The geochemical data of the stream sediments indicated Au is in the range of <0.05 to 11 ppm, Ag: <0.05 to 16 ppm, Cu: <0.02 to 134 ppm, Pb: <0.02 to 54 ppm, Zn: <0.02 to 60 ppm, Ni: <0.02 to 733 ppm, Cr: <0.02 to 202 ppm, Co: <0.02 to 38 ppm, Cd: <0.02 to 11 ppm and Mn: <0.02 to 780 ppm. The geochemical data of the panned concentrates are highly variable. Au is ranging from <0.05 to 45 ppm, Ag from <0.05 to 20 ppm, Cu from <0.03 to 350 ppm, Pb from <0.02 to 203 ppm, Zn ffrom <0.02 to 131 ppm, Ni from <0.02 to 699, Cr from <0.02 to 541, Co <0.02 to 47, Cd from <0.02 to 6 ppm and Mn from <0.02 to 987. The data was analyzed using integrated geostatistical and GIS analysis to look for data dimensions and to delineate target areas for potential exploration. The statistical methods such as histogram, box plot, correlation matrix and factor analysis were performed on data in order to get idea of the elemental distribution and geochemical associations. The percentiles (50^{th}, 75^{th}, 90^{th}, 95^{th} and 99^{th}) integrated with histograms were found useful for distinction between anomalous and background concentration. Geochemical maps were produced in Arc-GIS 10 for panned concentrates and stream sediments by plotting data on topographic maps (1:50,000) and regional geological maps in order to spatially link samples to particular area.

The panned concentrates provide better results for Au, Ag and base metals as compared to stream sediments. The poor geochemical correlation of Au with ore forming elements in both stream sediments and panned concentrates indicated placer origin. The spatial association of Au with River Indus and Kabul also verify this fact. The spatial data analysis was also found useful for base metals association of Cu-Zn in Swabi and Mardan, Pb-Cd in district Nowshera and Ni-Cr-Co-Cu in district Charsadda. It is concluded that spatial data analysis together with statistical analysis are very useful to identify target areas for Au, Ag and base metal in Peshawar basin.