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Use of multiple attributes decision-making Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for Ghare-Gheshlagh calcite in determination of optimum geochemical sampling sites

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Introduction

Several valuable calcite deposits are located in Ghare-Gheshlagh, south basin of Urmia Lake, NW Iran. Ghare-Gheshlagh area is situated in the northern part of tectono-sedimentary unit, forming NW part of Tertiary Sanandaj-Sirjan geological belt (Stocklin and Nabavi, 1972). The predominant rock types of the area include light color limestones (Qom Formation) and Quaternary alluviums and underlined dolomite in depth (Eftekharnejhad, 1973). The thickness of these units varies between 10 cm and 6 meters and up to some hundred meters in length.
In the present study, the effect of geochemical parameters responsible for precipitating calcite from the carbonate aqueous fluids is interpreted by the TOPSIS method to find the most preferable sampling sites and geochemical data.

Materials and Methods

A total of 20 samples were taken from a NE-SW trending profile including 15 calcites of fresh surface outcrops (5 samples per each colored calcite units) in order to determine the nature of the rocks. The mineral assemblages were analyzed by optical methods in combination with XRD powder diffraction analysis. Major elements were determined by X-Ray Fluorescence Spectrometry (XRF), trace and rare earth elements were determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in Geological Survey of Iran.

Results

The abundances of trace elements were normalized to the continental crust values (Taylor and McLennan, 1981). The green calcite revealed enrichment in Rb and Sr, while green and white calcite were enriched in U. The U enrichment in the green calcite indicates the reduction condition of deposition. Incompatible elements such as Ba, Th, Nb and P depleted in all calcites. Varying the Sr/Ba value between 3.18 and 5.21% indicates the continental deposition environment and non-magmatic waters as well (Cheng et al., 2013). The Sr^{2+} content of calcites varies from 123 to 427 ppm, indicates suitable condition for calcite precipitation.
Eu anomalies for green, white and pink calcites were varied 0.087, 0.247 and 0.997 respectively. The low amounts of Eu anomaly for green and white calcites attributed to low rock/fluid ratio (Nesbitt et al., 1990) and relatively more pH value (Cheng et al., 2013), however, increasing the Eu anomaly may be due to high rock/fluid ratio and less pH value. Ce anomalies are 0.0241, 0.0113 and 0.0131 in pink, white and green calcites respectively. The most negative Ce anomaly values show that calcite have precipitated under reduction conditions (Nesbitt et al., 1990).

Discussion

Recently, multiple attributes decision-making techniques help scientist to solve decision-making problems related to various controlling factors (Zhijun et al., 2013). One of these techniques is a Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) which is a quantitative weighted method (Momenei 2006). The identified criteria are CaO abundant in solution (C1), Eu anomaly (C2), Ce anomaly (C3), Sr abundant (C4) and volume (C5). The Index-Rock matrix

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also includes A1, A2 and A3 alternatives; as pink, green and white calcite respectively.

The weighted normalized decision matrix can be calculated by multiplying the normalized evaluation matrix with its associated weight to obtain the result. The result show that Eu anomaly, volume, Sr abundant and Ce anomaly in order have higher role to investigate the geochemical study of area. Calculation of the relative closeness to the ideal solution (Cl *) for pink, green and white calcites are 0.837, 0.445 and 0.157 respectively. It can be deduced that the most preferable calcite to be sampled for investigating geochemically are pink and green calcites.

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