

Anomalously low $\delta^{18}\text{O}$ values of oxygen dissolved in groundwaters at a uranium mine

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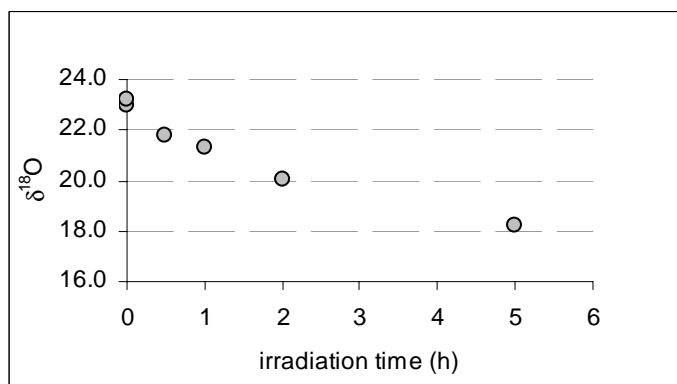
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Atmospheric oxygen with a constant $\delta^{18}\text{O}$ value of +23.5‰ is the dominant source for molecular O_2 present in subsurface environments. In the subsurface, O_2 may be consumed by various processes including organic matter decay, respiration, and oxidation of reduced metals. Biogeochemical O_2 consumption reactions preferentially consume the ^{16}O over ^{18}O . As a result, isotopic composition of O_2 in the subsurface becomes ^{18}O enriched and the resulting $\delta^{18}\text{O}$ values are greater than the initial +23.5‰.

The isotopic composition of dissolved oxygen in groundwater samples collected at a uranium mine in northern Saskatchewan, Canada were characterized by anomalous ^{18}O depletion with associated $\delta^{18}\text{O}$ values as low as +4.4‰. Subsequent to these observations, air saturated water samples were irradiated at the nuclear reactor facility for 0.5, 1, 2 and 5 h. The isotopic composition of O_2 present in headspace yielded a trend of increasing ^{18}O depletion with increasing irradiation time (Fig. 1). These observations suggest that water radiolysis may be responsible for the anomalous ^{18}O depletion observed in northern Saskatchewan groundwaters in proximity of uranium bodies. Further testing is being conducted; however if the ^{18}O depletion observed in the groundwater is attributed to radiolysis, oxygen isotopic anomalies may prove to be an exploration tool for the uranium mining industry.

Figure 1: Isotopic composition of water dissolved oxygen showing a trend of increasing ^{18}O depletion with irradiation time.



Technology of accounting of water exchange parameters at prospecting and exploration of carbon dioxide-bearing mineral waters

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The developed technology is assumptive to partial automate evaluative of stage of investigation for carbon dioxide mineral waters to use informational analysis in the combination with the elements of the theory of “discerning forms” (Lisenkov A.B., Goppa V.D.) This is essentially heuristic approach, because it allows combining the apparatus of the theory “discerning forms” and the experience of experts, working in the regime of dialogue with computer technology. The new technology realizing in four stages:

1. The selection of initial exponents for the informational research models. The circle of the exponents is expedient to limit to the list a-priory influential or changing the composition of carbon dioxide mineral waters. In our opinion for these purposes could be allotting next groups of the exponents: landscape, geologic, hydro geologic, tectonic and man-caused load, as well as three groups of the exponents (landscape, tectonic, man-caused load) might be obtaining with consume of the result of encode the SFP. The remained exponents might be received from the results of preliminary and particulars research, experience of exploitation, so as with consume GIS-technology.

2. The formation informative search models are emanating in two stages: on first stage it has to estimate information of the initial exponent’s correlative with function of purpose and selection informative. On second stage, from single indications we composing complex by the method of sorting and calculating the information likewise correlative with function of purpose. From the most informational compound indications is composing train matrix, which presents it the image of learned region and circulation carbonaceous mineral waters (informational search model).

3. Testing informative model accomplishing by the way juxtaposition the test part with form. In case if the model is effective, so on it basis realizing resolution conjectural problem (search sections are suitable for putting-up explorative works), i.e. accomplishing next fourth stage. In the other case is realizing return to the first and second stages. The experience of structure similar models for Kislovodsk territory group of entrails the carbon dioxide mineral water has shown it adequate efficiency and combination the informative indications is stressing the role of thickness water reservoir breed in forming chemical composition of mineral water, the role of tectonic certain configuration and extension in orientation fluid’s streams and also the influence of natural or man-caused border of pressure on mass carrying carbonic acid.

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