

PETROLOGICAL FACTORS CONTROLLING THE GEOGENIC ORIGIN OF HIGH FLUORIDE CONCENTRATIONS IN PRECAMBRIAN AQUIFERS OF CENTRAL BENIN, WESTERN AFRICA

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In the administrative region called "Département des Collines" in central Benin, fluoride concentrations in groundwater generally exceed the guideline values (1.5 mg/L) and are locally above 7 mg/L.

In this area, the aquifer is included in a Precambrian basement made of migmatitic gneiss and granites. Recent hydrogeochemical studies have shown that the presence of fluoride in groundwater in this area essentially results from natural processes (geogenic origin). The aims of the present investigation is to determine the main sources of fluorine in the basement and to estimate the role of different characteristics (petrography, mineralogy and geochemistry) of the geological layers on the mineralization and the high fluoride (F-) contents in groundwater.

Thirty-five rock samples were collected in different areas that display contrasting concentrations of fluoride in groundwater. The analyses carried out on these rock samples show that fluorine contents vary between 100 and 2900 ppm. Several fluorine-bearing minerals such as hydrous minerals (biotite, muscovite, amphibole), titanite, fluorite, fluorapatite and, to a lesser extent, fluor-allanite, epidote and chlorite have been identified.

Groundwaters with elevated concentrations of fluoride are found in geological formations that contain fluorine bearing minerals. Biotite occurring in the granitic formations has the highest fluorine content and appears as the most important contributor to the total fluorine content in the rock in the area.

These results served as a basis, in combination with regional information on geology and data on fluoride concentrations in groundwater, to perform a double cartography exercise on the regional in order to obtain (1) a map of estimation of fluoride concentrations in the groundwater by ordinary kriging and (ii) a probability map of exceeding the WHO guideline value (1.5 mg / L) of fluoride in water by kriging of indicators.

Keywords: fluorine, hydrogeochemistry, mineralogy, crystalline basement aquifer, Benin

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