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Search for Uranium Source in Warcha Sandstone, Salt Range, Pakistan, using SSNTD Technique

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Abstract

The similarity in sedimentary depositional characteristics of the Warcha Sandstone of Nilawahan Group in the Salt Range to the uranium bearing sandstones of Siwalik Group in the foot hills of Himalaya and Sulaiman Ranges, Pakistan, tempted geologists to investigate the former group for the occurrence of uranium deposits in it. Like volcanic ash beds in Siwaliks, phosphatic nodules may be a possible source of uranium mineralization in Warcha Sandstone. Samples of phosphatic nodules occurring in the Warcha sandstone near Chakwal were collected and subjected to the solid state nuclear track detection technique for the determination of their uranium concentration. The uranium concentration in these samples ranges from (434 ± 32) to (964 ± 74) with an average of (699 ± 16) ppm. The high uranium content indicates that the phosphatic nodules may be the possible source of uranium mineralization in Warcha Sandstone. These results are quite encouraging and favor the idea of exploring the area in detail for any possible occurrence of uranium deposits.

Keywords: Uranium; Phosphatic nodules; Sandstone; SSNTD technique

1. Introduction

Sandstone uranium deposits occur in medium- to coarse-grained sandstones deposited in a continental fluvial or marginal marine sedimentary environment. Impermeable shale/mudstone units are interbedded in the sedimentary sequence and often occur immediately above and below the mineralized sandstone. Uranium precipitated under reducing conditions caused by a variety of reducing agents within the sandstone including: carbonaceous material, sulfides, hydrocarbons and interbedded basic volcanics with abundant ferro-magnesian minerals. Ore bodies of this type are commonly low to medium grade (0.05–0.4% U_3O_8) and individual ore bodies are small to medium in size (ranging up to a maximum of 50 000 t U_3O_8). Depositional environments of these deposits may include continental-basin margins, fluvial channels, braided stream deposits and stable coastal plains.

The Siwalik Group of sedimentary rocks is the major source of uranium deposits in Pakistan. The Siwalik rocks occur along the southern flanks of the Himalayas and consist predominantly of molasse sediments comprising sandstones, siltstones, mudstones and conglomerates. The characteristic sedimentary features of the Siwalik rocks such as frequent occurrence of cross-bedding, ripple marks, vertebrate fossils and wood logs, and the association of pebble and cobble-sized fragments with sand size detritus are suggestive of shallow water deposition for these rocks. These

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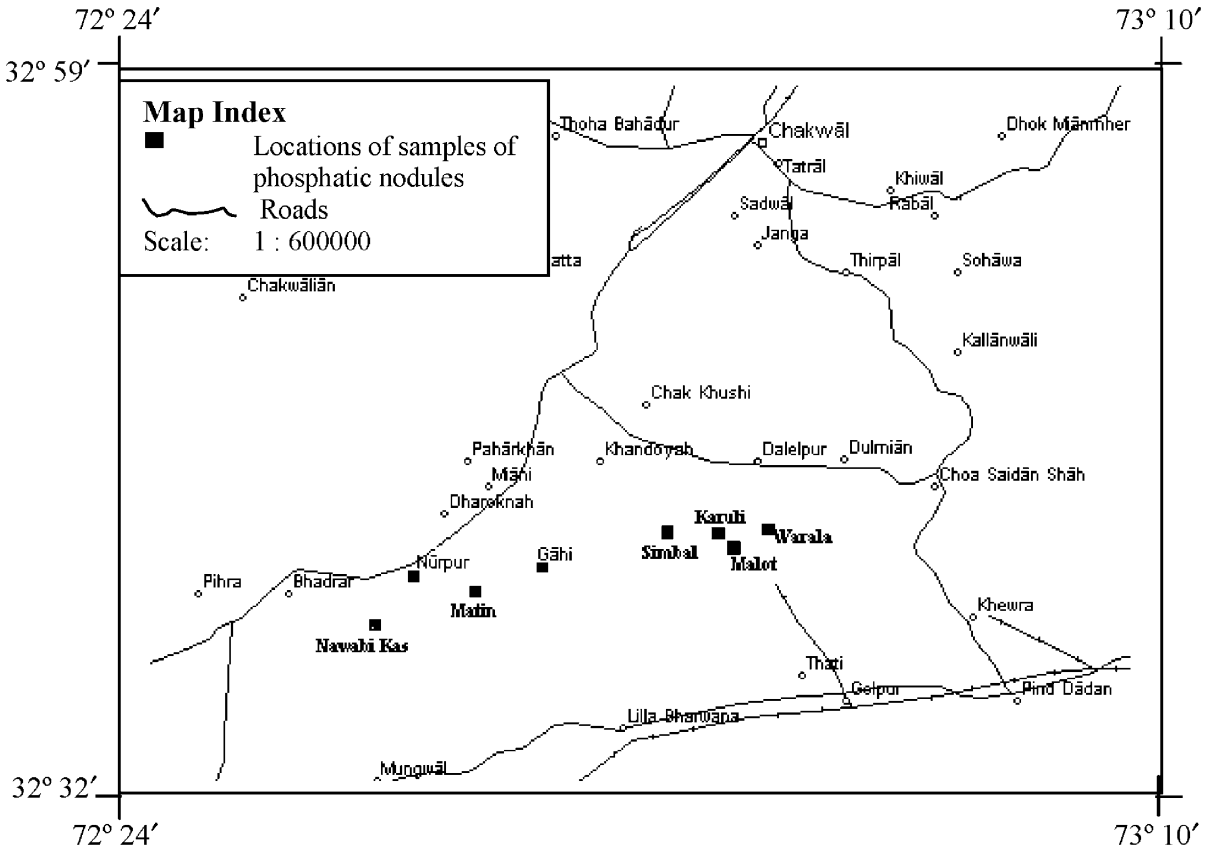

Fig. 1. Map showing locations of samples collected from the Chakwal district. These locations include the areas of Nawabi Kas, Nurpur, Matin, Gahi, Simbal, Karuli, Malot and Warala in the south and south west of Chakwal district.

lithological characteristics favor braided stream deposition under swampy conditions (Abid et al., 1983).

Pakistan produces about 2000 MW of electricity but that demand has increased many folds due to industrialization and population growth. Our hydroelectric sources are limited and thermal power production is beyond our reach due to the high import bill for oil. As a result the best alternative to generate electricity is by using nuclear fuel, uranium. Our uranium deposits in the Siwalik System of rock are being depleted. To cope with our future requirements of power generation, we need to search for new uranium deposits. The best alternative for this purpose is to search for uranium deposits in the Warcha Sandstones of Nilawahan Group exposed extensively in the Salt Range.

- Having sedimentary features and lithological characteristics nearly similar to the Siwalik Group, the Warcha Sandstone of Nilawahan Group, Salt Range provides ideal conditions for occurrence of potential uranium deposits. The presence of uranium mineralization in the Nilawahan Group, Eastern Salt Range has been reported in a couple of recently unpublished reports (Azizullah et al., 2003; Nisar, 2003). The Warcha Sandstone of the Nilawahan Group is of special interest containing phosphatic nodules, and is composed of sandstone, shale, conglomeratic beds and some carbonaceous shale in the Eastern Salt Range. The presence of phosphatic nodules in the Warcha Sandstone, Eastern Salt Range supports the idea and requires detailed study of any uranium mineralization associated with these nodules. These phosphatic nodules are scavengers of heavy metals, particularly, rare earth elements and uranium. Furthermore, the geology of the eastern part of the Salt Range is also favorable for concentrating uranium to form deposits. Several uranium and thorium anomalies in the eastern part of the Salt Range have been discovered in geological and radiometric surveys carried out during 1992–1993. More promising areas for hosting significant uranium resources in the Eastern Salt Range have also been delineated (Azizullah et al., 2003).