minerals

Editorial

Editorial for Special Issue "Geology of Uranium Deposits"

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Citation: Wilde, A. Editorial for Special Issue "Geology of Uranium Deposits". *Minerals* **2021**, *11*, 951. https://doi.org/10.3390/min11090951

Received: 24 August 2021
Accepted: 28 August 2021
Published: 31 August 2021

The study of uranium deposits is crucial for the discovery of much-needed new resources of uranium. Most current supply–demand scenarios require a major investment in new mines to satisfy the growing requirements of reactors under construction as well as those in the planning phase. This means that there is a compelling need to discover new deposits of uranium throughout the next decade. A precipitous drop in uranium prices during the 1980s led to a substantial reduction in research into uranium deposits, which (with the exception of China) has persisted to this day. There is a clear need for new research into the various types of uranium deposits using modern mineral systems, thinking, and applications of the many new technologies that have been developed since the heyday of uranium deposit research. This Special Issue presents five papers bringing together some of the latest research into uranium deposits, ranging from broad reviews to more detailed deposit studies.

The papers by Wilde [1] and Bruce et al. [2] present reviews of the shear-zone-hosted and unconformity types of deposits, respectively. Wilde [1] proposes that deposits formerly known as "albitite-type" or "metasomatite-type" (IAEA classification) are better regarded as shear-zone-hosted. This is an economically important group of deposits that is widely distributed, with examples mined in Brazil, Canada, and Ukraine. The paper presents a descriptive model of the deposit type, and provides a mineral systems framework in which to consider controls on deposit formation. Importantly, it identifies areas of uncertain or absent data that require further research (and there are many).

The Bruce et al. paper [2] provides a substantial review of the unconformity-type of uranium deposit, which currently accounts for approximately 20% of global uranium production, mainly from Canada's Athabasca Basin. The paper also discusses how to predict the location of unknown deposits using an innovative approach to geophysical data processing and interpretation that offers a virtually unbiased means of detecting cryptic basement structures. Fuzzy logic mineral potential mapping has been demonstrated to be a useful tool for delineating areas of high potential for hosting economic uranium concentrations. The resulting prospectivity model not only "rediscovers" known uranium mineralization, but also highlights several other areas prospective for unconformity-type uranium deposits.

Two papers deal with deposit-scale studies of sandstone-hosted uranium mineralization. The paper by Schmid et al. [3] presents new data from the Bigryli U-V deposit in Australia's Ngalia Basin. The deposit is similar to the continental, fluvial Saltwash-type of sandstone-hosted U-V deposits of the Colorado Plateau, USA. The paper provides a comprehensive description of the deposits, focusing on uranium and vanadium mineralogy. Coffinite and uraninite are the main uranium minerals, whereas vanadium is hosted by a range of minerals, including roscoelite, vanadian illite, corrensite, altered detrital biotite, montroseite, haggite, doloresite, and altered detrital Fe-Ti oxides. Mineralized zones are enriched in Se, Li, Ba, Be, Mo, Mg, and Fe. The authors present an entirely new mineralization model, involving an interplay between solution–precipitation processes, detrital transport, and post-depositional U remobilization.

The second of these two papers by Qui et al. [4] deals with sandstone-type uranium deposits in the Erlian Basin of China, and considers the relationship between sedimentary organic matter, migrating oil and gas, and sandstone-type uranium. The research is an attempt to prove a significant role for migrating hydrocarbons in uranium mineralization, potentially laying to rest a long-standing controversy. Several uranium deposits of the Erlian Basin were investigated using a variety of techniques, but notably, Raman and infra-red spectroscopy, gas chromatography, and analysis of carbon isotopes. The authors describe two stages of uranium mineralization. The volumetrically insignificant Stage I is defined by uranium enrichment within sedimentary organic matter. The main mineralization, Stage II, is inferred to be related to mobile hydrocarbon fluids, whereby migrating hydrocarbons act as reducing agents for aqueous uranium.

The fifth paper, by Li et al. [5], presents field, petrographic, and mineralogical data from the Mianhuakeng granite-type uranium deposit, Guangdong Province, China. Uranium minerals at Mianhuakeng occur in veins and veinlets or disseminated in granite and are paragenetically associated with fluorite, quartz, pyrite, and calcite. A particular focus of this study is the relationship between uranium minerals and pyrite. The authors propose a genetic model in which uranium was introduced via a reducing hydrothermal fluid sourced in the mantle. Uranium precipitation is inferred to be due to declining pressure and temperature as this fluid moves upwards though the crust, as well as changes in pH, rather than redox reactions as previously hypothesized.

I hope that this volume represents a reawakening of research into uranium deposits, thereby helping to discover new resources. These additional resources will be sorely needed as the world moves towards dominance of green energy.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

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