17. SUMMARY AND CONCLUSIONS

In the region near the Swakop River a geochemical cycle of uranium was established which comprises the distribution of uranium in three stages, the basement rocks, the subsurface waters and the sites of accumulation. Through all these stages the geological and geochemical aspects of uranium mineralization were investigated in order to determine the geochemical factors that controlled the formation of epigenetic deposits in the Namib Desert.

Paragenetic relationships between the basement rocks were established from rare-earth element distributions. The Bloedkoppie and Gawib Granites are late-syntectonic in age. The significance behind the origin of the Bloedkoppie Granite is that is was derived by partial melting from the Nosib Group rocks. Therefore the Nosib Groups was the initial source of the uranium in this later-forming granite which ultimately formed contributed to the supply of the epigenetic uranium in the Gawib River Valley.

Uranium was leached from the source rocks by the corrosive action of saline subsurface waters. The geochemistry of these waters provided an insight into the chemical processes involved during the epigenesis of the calcretes. From the data it was possible to infer which mineralogical phases were stable in the environment of the Namib Desert. The waters have a high degree of calcite saturation, indicating that the formation of calcrete is still in progress. Montmorillonite and not kaolinite is the stable clay mineral. It was predicted that both soddyite and carnotite would coexist in calcrete and this was confirmed by X-ray diffraction analysis.

The distribution of uranium in the subsurface water is controlled by the pH and carbonate content, with uranium principally in the form of the soluble uranyl dicarbonate complex. Dissociation of the UDC by soil suction and nucleation of the uranyl ion on montmorillonite were the main controlling mechanisms involved in the precipitation of carnotite and soddyite.

Using the concentration of uranium in the subsurface water for prospecting purposes the following criteria were found to apply:

(a) U ≥ 30 ppb - potential uranium mineralization nearby but anomalous values do not necessarily imply a deposit.

(b) U<30 ppb - no uranium mineralization indicated but low background values do not necessarily mean the absence of a deposit.

Uranium is still circulating in the duricrusts and source rocks, as isotopic equilibrium between uranium and its daughter products has not been completely established. The isotopic ages were given for the uranium mineralization in the Gawib River Valley. For the closed-system and open-system models ages of 63 000 years and 30 000 years respectively were obtained. The discrepancy in ages is again indicative of migrating uranium which seems to obey the open-system model more closely.

The final stages of the geochemical cycle of uranium comprise the Atlantic Ocean and the diatomaceous muds on the continental shelf. The ocean water is undersaturated in uranium (mean U = 0,003 ppm) and other elements, whereas the diatomaceous muds are enriched in those elements (mean U = 26 ppm). Organic matter was the main precipitating agent and the heterogeneous distribution of uranium, molybdenum and vanadium is due to the selective uptake of these elements by particular organic compounds.

A classification system was proposed that would provide guidelines concerning favourability criteria for uranium mineralization in this region.