Atso Vorma

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Atso Ilmari Vorma, Research Director at the Geological Survey of Finland, died in Espoo on 23 January 2021. He studied at the University of Helsinki, majoring in geology and mineralogy, and completed his master's degree in 1956 and his PhD in 1963. Vorma was an internationally known mineralogist and a researcher of Finnish rapakivi granites.

Vorma began his long career at the Geological Survey of Finland in the beginning of 1958. His ability to scientific research was noticed early on. He was asked to study a bismuth-bearing mineral sample that Aarne Laitakari had collected from the Orijärvi mine in the 1930s. Vorma used X-ray diffractometers to determine the exact unit cell dimensions of the mineral. It turned out that it was a new mineral, with the formula $Bi_4(Se, S)_3$, and Vorma named it *laitakarite*.

Vorma spent the years 1961–62 as a Postgraduate Fellow at the University of Cambridge in England. There he was asked to study the crystal structure of stokesite, a rare tin mineral found in Cornwall. The studies showed that stokesite represented a new kind of chain silicate. Vorma presented the research findings in his 1963 dissertation entitled *The crystal structure of stokesite* $CaSnSi_3O_8 \cdot 2H_2O$.

While working as a geologist and a researcher in the Petrological Department in the 1960s and 1970s, Vorma and his colleagues published three geological map sheets and a large number of mineralogical studies. Some of these studies deal with granite pegmatites. The 1965 study on the Pyörönmaa pegmatite in Kangasala included a detailed description of minerals containing rare earth elements. Several of these had not been previously described in Finland. Vorma discovered a new tin tantalum mineral in the Sukula pegmatite in Tammela, which was named sukulaite. His special expertise, crystal structure analysis, Vorma applied in a study determining the locations of Li, Na and K atoms and water in the unit cell of beryl. The studied beryl samples were from pegmatites in Finland and Mozambique. Together with Oleg v. Knorring and Peter H. Nixon, Vorma described from Congo a new tantalum mineral, rankamaite, in 1969.

A major part of Atso Vorma's research dealt with rapakivi granites in Finland. He published these studies mainly as monographs in the Bulletin series of the Geological Survey of Finland. In his study on the contact phenomena of the Wiborg batholith

(1972), Vorma showed that the batholith is surrounded by a roughly 5 km wide aureole in which the alkali feldspar of the Svecofennian country rocks has changed from microcline to orthoclase due to the thermal effect of the rapakivi intrusion. Based on the aureoles, Vorma was also able to conclude that the Suomenniemi rapakivi batholith is older than the Wiborg batholith. In terms of research on the mineralogy of rapakivi granites, the studies on the amphiboles and biotites of the Wiborg batholith and on zircon in the Laitila batholith also deserve a mention.

Atso Vorma's work entitled *Alkali feldspars of the Wiborg rapakivi massif in southeastern Finland* (1971) is particularly remarkable. With the help of abundant and detailed petrographic, mineralogical and chemical data, he was largely able to determine how the Al/Si ordering and the exsolution grade in alkali fealdspar portray the different granite types of the batholith and their formation conditions.

Based on his extensive knowledge on Finnish rapakivi granites and abundant new research data, Vorma published in 1976 a monograph entitled *On the petrochemistry of rapakivi granites with special reference to the Laitila massif, southwestern Finland*. In it he presents a summary of the rapakivi granite complexes in Finland, their petrographically and geochemically different granite types and the evolution of rapakivi magmas. Vorma also offered an interpretation of the origin of rapakivi magmas. According to his model, rapakivi magmas were formed in the lower crust as a result of ultrametamorphism during the compressional stage of the Svecofennian orogeny, but first remained there as intergranular pore fluids, until they were able to collect into magma chambers during post-orogenic distension and rise to upper levels. This model remains one possible explanation for the origin of rapakivi granites.

Having been appointed the Head of the Bedrock Department in 1980, Vorma concentrated on the administration and development of the department and gave up his own research. He supported and developed basic research, particularly bedrock mapping. In 1992, he was appointed Research Director, responsible for scientific research. In this post, he continued to defend the importance of geological basic research at the Geological Survey of Finland, which was undergoing an organizational change and shifting its focus to applications. He retired in 1996. Atso Vorma was elected a member of the Finnish Academy of Science and Letters in 1989 and honorary member of the Geological Society of Finland in 2000.

Atso Vorma spent his long career in office working at the Geological Survey of Finland. He never applied for professorships in universities. However, he promoted collaboration between the Geological Survey and universities in many ways. He held courses on geology, petrology, mineralogy and crystallography at the universities of Helsinki, Turku and Oulu and also worked as a docent at the University of Helsinki. He was a pre-examiner of dissertations, the opponent at several defences of dissertations, and an expert consulted when vacant offices were filled at the universities. He also arranged opportunities for university researchers to conduct supervised research in the laboratories of the Geological Survey. Vorma preferred to have his studies published in the Finnish Bulletin series instead of prestigious international series. Mineralogical research in Fin-

land from the 1950s to the 1980s was of high international standard and its leading names were Academician of Science Th. G. Sahama and Atso Vorma. After them, this important branch of geosciences has unfortunately faded. Atso Vorma was outspoken and did not hesitate to take a stand. As a colleague, he was also helpful and cooperative. His research projects offered rewarding work experiences.

Atso Vorma was married to Kirsti Marjatta Heiskanen since 1958. Kirsti passed away in October 2020. Atso and Kirsti are missed by their family of two daughters, three grandchildren and two great-grandchildren.

Obituary by Ilmari Haapala