



On the occasion of the 100th anniversary of Josef Zemann's birthday: a tribute to his scientific oeuvre

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On the occasion of Prof. Dr. Josef Zemann's 100th birthday, we, some of his colleagues and friends, initiated the publication of a Special Issue of Mineralogy and Petrology. We intended to honour the life work of a distinguished scientist, an outstanding teacher, and unique personality. Whilst already working on the many articles, however, we received the very sad news that Josef Zemann passed away peacefully on 16 October 2022, at the age of 99 years. We regret that Josef Zemann will no longer be able to accept our many good wishes, but he is unforgettable for all of us.

Josef Zemann was born on 25 May 1923 in Wien-Atzgersdorf, Austria. Despite economic struggles, his parents enabled his attendance of a grammar school, from which he graduated in 1941. Owing to a visual impairment he was not drafted into military service but could start to study at Universität Wien in autumn the same year. Excellent teaching and motivated teachers at the grammar school especially in the disciplines of natural sciences motivated him to strive for a teaching profession in chemistry, physics, and mathematics.

Rather by chance, he soon switched to mineralogy when he was called to an assisting position by Prof. Dr. Alfred Himmelbauer (1884–1943). The death of the advisor is often an obstacle to continuing the work that has just begun. However, Prof. Dr. Karl Ludwig Felix Machatschki (1895–1970) took over the position in 1944 as the successor and motivated Josef Zemann to continue with a dissertation. In these times during and shortly after World War II the situation was extremely difficult and precarious, even for the university and a student. On 17 July 1946 Josef Zemann received the degree *doctor philosophiae* (appraised by Prof. Dr. Felix Machatschki and Prof. Dr. Hans Leitmeier). The doctoral thesis was entitled “Über die Struktur des Pharmakosiderits” (‘On the structure of pharmacosiderite’). It is to be mentioned that the subsequent article “Formel und Strukturtyp des Pharmakosiderits” (‘Formula and structure type of pharmacosiderite’) was published as the very first article in the first issue of the journal *Tschermaks Mineralogische Petrographische Mitteilungen* (Zemann 1948); this journal was the predecessor of Mineralogy and Petrology. From 1946 to 1951 Josef Zemann held the position as a research assistant at the Institut für Mineralogie, where he worked mainly on crystal chemistry, and shortly later on petrography.

At the institute Josef Zemann met a former schoolmate: Anna Hedlik. She was only one month younger than him and had attended the same elementary and secondary school. The extraordinarily good teachers and the stimulating lessons prompted her to pursue becoming a teacher in natural science subjects. During her education she also had to take courses in Earth sciences, including mineralogy where she met Josef Zemann. Besides the education as secondary school teacher in natural history, chemistry, and physics, she started a doctoral study of mineralogy.

In October 1950 Josef Zemann presented his habilitation thesis entitled “Die Mineralien Schafarzikit und Trippkeit” (‘The minerals schafarzikite and trippkeit’) to the

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Fig. 1 Josef Zemann in October 1951, in the X-ray laboratory of Martin J. Buerger at MIT. Photography provided by Josef Zemann Jr., with permission

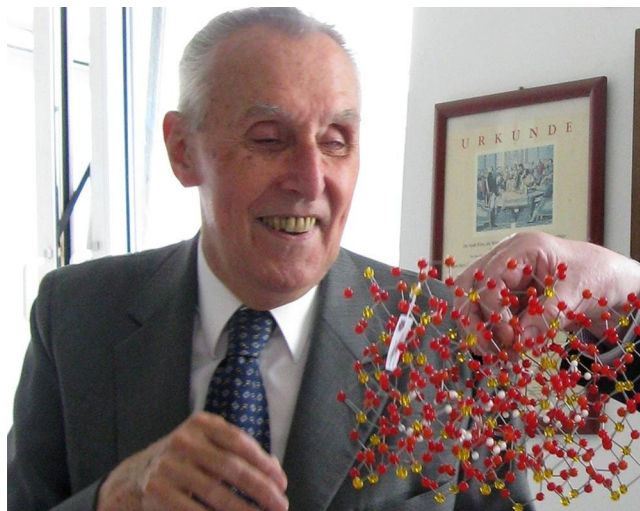


Fig. 2 During a celebration of this 85th birthday in 2008, Josef Zemann received a model of the crystal structure of zemannite, a tellurite mineral named after him. Photograph by Kurt Mereiter, with permission

Professors' Council. In 1951 he obtained the *venia legendi* for the entire fields of mineralogy and petrography and therewith he qualified himself as a university lecturer. The same year he received a U.S. State Grant. It allowed him to spend a year at the Massachusetts Institute of Technology (MIT) with Prof. Martin J. Buerger (1903–1986), one of the leading crystallographers world-wide at that time. Zemann used his MIT stay to enhance his methodological skills (Fig.

1). Anna Hedlik also obtained a fellowship at MIT. During their time in the USA they married in Cambridge, MA.

Shortly after his return to Wien, Josef Zemann was appointed associate professor at the new founded Mineralogisch-Kristallographisches Institut, Georg-August-Universität Göttingen. Later he became a full professor there. As director he headed this institute for 15 years. During his time in Göttingen, Josef Zemann dealt with important matters of crystallochemistry, such as coordination issues of Li, Cu and Te atoms, electrostatic lattice energies, as well as crystal absorption spectra in the infrared range. His years in Göttingen constituted a fulfilled time, thanks to the great working conditions and an academically inspiring atmosphere.

In 1967 Josef Zemann returned back home to become a full professor at the Institut für Mineralogie, Universität Wien. Here he continued the successful work that had started in Göttingen and expanded his field of research to the growth and synthesis of crystals. He headed the institute – which was renamed Institut für Mineralogie und Kristallographie in 1969 – until he became Professor Emeritus in September 1989.

Josef Zemann leaves a grand academic legacy. His work was primarily dedicated to the crystal structure determination and crystal chemistry of minerals and inorganic compounds by means of X-ray and neutron diffraction. In honour of his research on the stereochemistry of tellurium(IV)-oxysalts, the tellurite mineral zemannite, $[\text{Zn}^{2+}\text{Fe}^{3+}(\text{TeO}_3)_3]_2[\text{Mg}(\text{H}_2\text{O})_6 \cdot n\text{H}_2\text{O}]$, $n \leq 3$, was named after him (Mandarino and Williams 1961; Mandarino et al. 1969).

Calculating electrostatic lattice energies showed the way towards a modern atomistic modelling of crystal properties. His infrared (IR) spectroscopic investigations of minerals were ground-breaking, particularly in the field of structural $(\text{OH})^-$ groups. He applied polarized IR radiation and crystallographically oriented, grounded crystal slides for the localization of hydrogen bonds. At that time, it was practically impossible to locate H atoms with X-ray methods. More milestones of Josef Zemann's research concern the Jahn-Teller-affected stereochemistry of divalent copper in oxygen-based minerals, and a series of papers deal with the crystal chemistry of carbonates, focussing on both the structure types and their relations, as well as on the aplanarity of the carbonate group.

Josef Zemann's oeuvre encompasses over 180 publications (Tillmanns 2013a), including academic articles, monographs and book chapters, published from 1947 to 2012, besides preliminary notices and abstracts. From 1966 to 1978 he acted as publisher, until 1996 as co-publisher of *Tschermaks Mineralogische Petrographische Mitteilungen*, from 1987 on renamed *Mineralogy and Petrology*, where he still was Editor Emeritus until his passing. Also, he was

long-term representative of Austria in the International Mineralogical Association (IMA) Commission on New Minerals and Mineral Names.

The significance of his academic work was honoured through numerous awards, amongst them the Abraham-Gottlob-Werner Medal in Silver (Deutsche Mineralogische Gesellschaft), the Erwin Schrödinger Award and the Gustav von Tschermak-Seysenegg Prize (Österreichische Akademie der Wissenschaften), the Silver Medal of Masaryk University (Brno), the Gold Medal of Comenius University (Bratislava), as well as the Emanuel Bořický Medal (Charles University, Prague). Josef Zemann's reputation within the scientific community is also verified by various academic and honorary memberships. He became a Corresponding Member of Österreichische Akademie der Wissenschaften in 1967 and was elected Full Member in 1972. He was Member of the Deutsche Akademie der Naturforscher Leopoldina (Senator during 1987–1997). He was also Corresponding Member of the Niedersächsische Akademie der Wissenschaften zu Göttingen, as well as Honorary Member of the Hungarian Academy of Sciences, and Corresponding Member of the Polish as well as the Croatian Academies of Sciences. Josef Zemann was an active member of many mineralogical organisations. For 20 years he served in the Managing Board of the Österreichische Mineralogische Gesellschaft (ÖMG), among others as Chairman (1969–1971) and Vice-chairman (1974–1978). The General Assembly of ÖMG elected him as Honorary Member (1981) and Honorary President (2003). Furthermore, Josef Zemann was Honorary Fellow of the American Mineralogical Society and Honorary Member of the Mineralogical

Societies of USSR (later Russia), Poland, Slovakia, Germany, and Romania. For a complete list of Josef Zemann's academic memberships, honorary fellowships and awards see Tillmanns (2013a,b).

As a long-time head of the Institut für Mineralogie und Kristallographie, Josef Zemann was deeply connected to the *Alma Mater Rudolphina Vindobonensis* (Latin for Universität Wien). He was a highly respected academic teacher and active scientist well into advanced age. He had the gift to captivate listeners of all ages, he found the right words no matter if they were interested laymen or highly specialized scientists, no matter if they were children or adults. Despite his impressive career and the many and high honours he received, he was always an understanding institute director who took care of the small and big problems of his employees and colleagues. With his academic curiosity, his gift for observation, his tireless productivity and commitment, he has influenced and inspired generations of scientists. Josef Zemann (Figs. 2, 3) will be remembered as an esteemed professor, teacher, mentor, scientist, and friend.

The 23 scientific papers of this Special Issue represent the wide interests and the broad knowledge of Josef Zemann. Without any doubt, the majority of topics relate to the field of mineralogical crystallography in a wider sense, encompassing studies of new minerals, unusual building units, novel structures and relations to common structure types, as well as considerations on structural details such as ordering, substitution, partial occupancies, and symmetry relations. In addition, issues of mineral spectroscopy in the visible spectral range and vibrations of hydrous species in the infrared range are covered. Eventually, economic geology is contained as well as methods of geochemistry to unravel the Earth's early history and questions of archaeology.

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Fig. 3 In 2011, still in good shape at the age of 88 years, Josef Zemann enjoyed attending a walking-tour of institute members across Bisamberg hill near Wien followed by a stop in a local winery. Photograph by Manfred Wildner

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