

# Memorial to A. E. (Ted) Ringwood

## 1930–1993

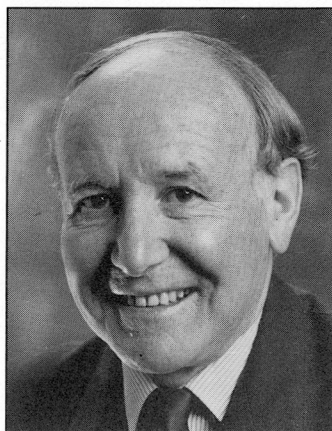
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With the death of Ted Ringwood on November 12, 1993, earth science lost prematurely one of its most fertile minds and most effective experimental scientists. His professional career was international in its outreach, but centered within the Australian National University. His scientific presentations at international meetings were characterized by presentation of new data, by independence and original thought, and by clarity and conviction in presentation. An enthusiast for science, he equally saw that science must solve problems and create opportunities of relevance to society as a whole.

Ted Ringwood's influence in earth sciences has been profound through more than 300 scientific articles and two books, but principally through his vigorous presentation of new concepts and new data and his willingness to confront established models where he perceived them to be narrowly based, internally inconsistent, or inconsistent with observation or experiment. His research, although motivated by fundamental questions about Earth, its origin, nature, and internal processes, also effectively bridged into applied research in the safe disposal of nuclear waste and in the design and manufacture of ultra-hard materials. Projects of both applied science and fundamental science were carried out in the same high-pressure laboratory and with the same creative leadership. He cultivated both a deep theoretical knowledge and experimental skills; both were fired by questioning established models and by a willingness to experiment and to learn from experiment and observation.

Ted Ringwood grew up in inner Melbourne, and between 1948 and 1956 he obtained a B.Sc. with honors, M.Sc., and Ph.D. from Melbourne University. His M.Sc. project included field mapping and petrology of granites and acid volcanics in the heavily forested Snowy River region of Northeastern Victoria. His early entry to the mineral industry was characterized by carting galena by pack-horse from a disused silver mine near Deddick, and selling it for lead shot manufacture in Melbourne. For his Ph.D. studies, he turned from applied and field geology to the new geochemical concepts of V. M. Goldschmidt and applied them to the prediction of new mineral structures that should be stabilized by the very high pressures and temperatures of Earth's mantle. This research led to a postdoctoral fellowship (1957–1958) at Harvard University, under the guidance of Francis Birch, and then to recruitment by John Jaeger to the fledgling Department of Geophysics at the Australian National University (ANU). He was appointed to a personal chair in 1963 and as professor of geochemistry in 1967. He led efforts to create the new Research School of Earth Sciences from what was then the Department of Geophysics and Geochemistry, and he was its second director, following Anton Hales, from 1978 to 1983. He remained committed to the ideal of ANU as a distinctively Australian center of international leadership in research, and his own work did much to contribute to this standing in the fields of earth science. He was supportive of colleagues at ANU in their independent lines of investigation, where he perceived them to have vision and to have potential outcomes of major importance.



He published two books, *The Composition and Petrology of the Earth's Mantle* (1975) and *The Origin of the Earth and Moon* (1979) which synthesized many of his diverse but related investigations. Major experimental studies included mineral transformations at high pressures and temperatures using "squeezer," piston-cylinder, diamond anvil, and multi-anvil devices. These were developed to increasingly refine models of the Transition Zone and of the role of subduction as a tectonic engine, and in the mantle convective cycle. Not only did Ted Ringwood remain for over 30 years in the front line of experimentalists who developed solid-media pressure apparatus and applied it to mantle minerals and compositions, he was also the most authoritative and comprehensive in his integration of the experimental studies with geophysical observations of the deep Earth. Equally, because of his lifetime interest in Earth's geochemistry and in the origin and evolution of the solar system, he integrated the mineralogical studies with models of chemical differentiation in Earth. Other major themes, many with colleagues, included the origin of basaltic and andesitic magmas; the gabbro to eclogite transformation; the nature and evolution of Earth's core; the chemical evolution of the planets and meteorites; the nature and origin of lunar basalts and the composition and origin of the moon. He used his geochemical insights and experimental skills to develop and patent the "SYNROC" process of encapsulating radioactive nuclear waste in appropriate, stable mineral structures. Similarly, he devised and patented new ultra-hard cutting-tool materials based on hot-pressed diamond-based composites and on cubic boron nitride. His outstanding characteristic was that he made original, often controversial, contributions to knowledge and understanding in each of these fields. He presented speculative hypotheses but followed up with experimental tests or sought for real-earth observations to confirm or deny the models presented. He could look back over a career studded with ideas, some now discarded, but others forming a foundation for science of the twenty-first century.

Ted Ringwood was one of the most internationally honored of earth scientists, receiving thirty medals or prizes and being elected to many of the world's most prestigious learned academics. He was elected a Fellow of the Australian Academy of Science in 1966, of the American Geophysical Union in 1969, of the Royal Society of London in 1972, of the Australian Academy of Technological Sciences in 1991, of the Geological Society of America in 1974, and as a Foreign Associate of the U.S. National Academy of Science in 1975. Among his most prized awards were the Bowie Medal of the American Geophysical Union, the Arthur L. Day Medal of the Geological Society of America, the Wollaston Medal of the Geological Society of London, the H. H. Hess Medal of the American Geophysical Union, the V. M. Goldschmidt Medal of the Geochemical Society, and the J. C. Jaeger Medal of the Australian Academy of Science. The Rosenstiel Award of the American Association for Advancement of Science, the Werner Medaille of the German Mineralogical Society, the Antonio Feltrinelli International Award of the Italian National Academy, and the Arthur Holmes Medal of the European Union of Geosciences attest to his international stature.

It is appropriate to quote Ted's own words from his address to the Italian National Academy in 1991 at the award of the International Feltrinelli Prize:

Our understanding of the Earth in all her aspects has developed dramatically during the last 25 years. This has been an exhilarating period to have been an earth scientist. I feel very fortunate and fulfilled to have been able to participate in some of these developments.

Ted Ringwood was a great scientist, and his international stature is a recognition that his work includes fundamental contributions spanning 35 years of creativity, debate, experimental demonstration, and accumulation of data and insights. His premature death is mourned by family, colleagues, and friends within his university and in learned societies and universities throughout the world.

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