SMEDG Life Membership Award 2018: Raymond Albert Binns

By Dr Anita Andrew

27 September 2018

Sydney

Ray Binns' career has been underpinned by extra-ordinary mineralogical and petrological skills that he used to resolve host-rock issues of importance to ore genesis and mineral exploration, mostly featuring extensive collaboration with industry geologists. His impact goes beyond his science. Ray has taught numerous students who entered the mineral exploration and mining industries, many of whom have reached executive positions. At CSIRO he was an inspirational leader and mentor to many.

Ray graduated in 1959 with First Class Honours and a University Medal, awarded for a thesis on Cow Flat, a former VMS and gold-mining centre near Bathurst NSW. He was awarded a scholarship by Trinity College, Cambridge to undertake a PhD on metamorphism in the Willyama Complex. This research demonstrated that "granulites" formed from high-temperature regional metamorphism rather than from repeated metamorphism and established temperature-dependent changes in mineral compositions within the amphibolites. This included first K–Ar radiometric dating of Precambrian events at Broken Hill, the second-ever mineralogical paper to use electron microprobe data, and the first terrestrial occurrence of the mineral *clinohypersthene.* Following his PhD studies, Ray was appointed to a Lectureship in Geology at UNE, where he continued investigations at Broken Hill. With funding from one of the first awards from the newly-established Australian Research Grants Committee (ARGC), he conducted high pressure hydrothermal experiments to quantify P–T conditions at the amphibolite–granulite facies boundary, pertinent to Broken Hill metamorphism and its effects on stratiform ores.

At UNE, Ray with his students discovered a new antimony–gold lode at Hillgrove and resolved a faulted relationship of two other lodes, extending production from the field for several decades. He recognised the 'Wongwibinda Metamorphic Complex' of schists, gneisses, migmatites, and associated granitic intrusions, which in collaboration with John Richards (ANU), produced an unexpected K–Ar Permian age and was awarded the Archibald D. Olle Prize of the Royal Society of New South Wales.

Working with John Wilkinson at UNE, Ray recognised high-pressure 'megacrysts' in Cenozoic alkali basalts and demonstrated geochemical fractionation processes in magmas at deep crustal and upper mantle conditions. This research was a forerunner to the recognition of 'indicator minerals' for diamond prospectivity and exploration.

In late 1965, while on sabbatical leave, Ray studied the British Museum's extensive collection of stony meteorites that were of renewed interest in the lead-up to the Apollo Space Program. Identifying the significance of metamorphism in chondritic meteorites, he recognised increasing metamorphic intensity was a consequence of increased burial on a cosmic parent body that possessed an internal heat source, a concept at first rejected by cosmologists but that later, became the accepted paradigm.. Ray continued his research on meteorites throughout his career, including descriptions of rarer stony meteorite types from the Nullarbor Plain. He discovered and named *ringwoodite*, the high-pressure polymorph of olivine formed during cosmic collisions. His international reputation attracted offers from several US universities affiliated with the NASA space program, one carrying the possibility of becoming an astronaut.

Ray joined UWA in 1971 as Reader in Geology, and with David Groves and students initiated a major project 'Metamorphism and Nickel Mineralisation in Western Australia' funded by ARGC and industry through the Australian Mineral Industries Research Association (AMIRA). Between 1971 and 1976 the team conducted extensive field work traversing greenstone belts to delineate metamorphic patterns in the Eastern Goldfields. The effects of deformation and recrystallisation in formerly magmatic nickel sulfides were used to identify where metamorphism was itself the generative process, enhancing the rigour and effectiveness of company exploration programs. A metamorphic map of the eastern Yilgarn, the first for any Archaean granite–greenstone terrain globally, when combined with geophysical and stratigraphic information, was used by industry to assess regional prospectivity for nickel, and a decade later, for gold.

In 1977 Ray was appointed to CSIRO as Officer-in-Charge of its Sydney laboratory plus CSIRO staff at the Baas Becking Geobiological Laboratory (then at Bureau of Mineral Resources in Canberra) and was soon promoted to Chief Research Scientist and Assistant Chief of the Division. As well as major management responsibilities he led and contributed to research projects including uranium deposits in the Alligator Rivers province, exploration for deep-seated ("blind") and buried ores, gold deposits in Victoria, central western NSW, northern Queensland, and the Northern Territory, and massive base metal sulfides throughout eastern Australia. With the advent of rapid multi-element geochemical methods, Ray investigated "primary geochemical haloes" from a range of hydrothermal ore deposits in eastern Australia, foreshadowing the popularity today of "distal footprints" in exploration.

In 1985 Ray started a project using mineral deposition on the modern ocean floor as a 'natural laboratory' to examine and understand ore genetic processes and the potential value for exploration strategies on land. Recognising that the active 'black smokers' and sulfide mounds and 'chimneys' on mid-ocean spreading ridges were an imperfect analogue for VMS ores in the Paleozoic and Precambrian of Australia, in 1986 he commenced an extensive program of research cruises with CSIRO's new research vessel *Franklin* in marginal seas around Papua New Guinea, where there was evidence for submarine felsic volcanism in a back-arc setting. The program of research was developed through international collaborative links (Steve Scott, Toronto, and Dick Chase, Vancouver) and through the highly competitive use of research vessels (*RV Franklin*, *RV Akademik Mstislav Keldysh, RV Sonne, RV Yokosuka, HMAS Cook)*, manned submersible dives (*Mir, Russia* and *Shinkai-6500,* Japan) and ODP drilling using the *JOIDES Resolution.* These expeditions discovered, mapped and drilled seafloor sulfide and barite deposits and active low-temperature vents-fields of Fe–Mn–Si oxide/hydroxide at the PACMANUS site in back-arc Manus Basin. Samples provided the highest copper (up to 29 wt%) and gold (up to 89 g/t) grades for ocean-floor mineralisation in the Pacific and Atlantic oceans.

This work led to *Nautilus Minerals*, being granted an Exploration Licence over the PACMANUS site by the PNG Government. In 2006 and 2007, as a consultant to Nautilus, Ray undertook two cruises at Solwara-1 where exploration protocols using a remotely operated vehicle (ROV) deployed from surface vessels were developed leading to logging and geological interpretation in a drilling campaign using a ROV-mounted rig. Nautilus remains an active explorer in the southwest Pacific and developed seafloor mining equipment.

Ray's research career has been characterised by pioneering studies in a number of fields that then became the subject of expanded international efforts. Ray served his profession via committee service for national and international societies and on the editorial board of *Contributions to Mineralogy and Petrology* (1970 to 2000). He is a member of the NSW Police Service Committee of Experts (forensic mineralogy). His research has been recognised by appointment to Fellowships in a number of professional societies including the Geological Society of Australia and the Australasian Institute of Mining and Metallurgy, election to Fellowship in the Australian Academy of Technological Sciences and Engineering. He was awarded the Centenary Medal by the Commonwealth of Australia (for service to geology and the minerals industry). In 2002 Ray and his team were awarded the Chairman's Medal (CSIRO's highest honour) for research excellence. The citation reads:

> *'For their world leadership in the discovery and scientific investigation of active ore-forming systems on the ocean floor of the southwest Pacific. Application of this research has expanded industry's capability to find untapped mineral resources hidden within Australia's ancient geological environments."*