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Historical Records of Australian Science

Roy Woodall 1930–2021

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ABSTRACT

Facing a choice between postgraduate study and the world of work, Roy Woodall took the advice of his research supervisor at the University of California, Berkeley, to return to Australia and find ore deposits. He spent almost all his working life with Western Mining Corporation where, from 1967 to 2001, he was successively Chief Geologist, Exploration Manager, and Director of Exploration. From humble beginnings he formed and led the team that became Australia's greatest discoverer of ore deposits, including Olympic Dam, while he was recognised internationally as an icon in the mineral exploration world.

Keywords: earth sciences, geology, historical article, metals, mining.

Early life

In 1928, Woodall's parents emigrated from Britain to start a new life in Australia, and he was born in Perth, Western Australia (WA) on 3 November 1930.[1] But the Wall Street crash of 1929 led to the Great Depression and in Australia unemployment reached a record high of around 30% in 1932. This affected the Woodall family deeply and his father, like so many Australians, was unemployed. To feed a family of three children, Woodall's father undertook manual work on community projects, receiving food vouchers that made it possible for his mother to put food on the table.

His primary education was at East Claremont Practising School. It was called a 'practising school' because teachers-in-training from the nearby teachers' training college (the only one in the state) would practise at this school. Apparently, the school was good, and the teachers excellent. The school was about a mile from his home and he would walk there, often with one of his best friends; the friend was barefoot because his parents could not afford shoes, but Woodall's parents somehow managed to find shoes for him and his two siblings.

These early years of privation clearly had a deep impact on Woodall; he spent his life and his career striving, successfully, to improve the quality of life for Australians (Fig. 1).

He later attended Claremont Central High School where he again had excellent teachers. He sat the Junior Certificate and passed in eight subjects, but because of straightened family finances he had to leave school at sixteen and find work.

His first job was as a junior clerk in the Public Works Department and he was fortunate to be placed in the Hydraulics Division, where the engineers encouraged him to continue his education at night school. He studied English, mathematics, physics, geology and geography at the Perth Technical College and qualified for entrance to university; but disappointed the chief engineer by deciding to enrol in a science, rather than an engineering, degree.

In his first year at the University of Western Australia (UWA), Woodall studied physics, mathematics, chemistry, and geology, and then carried mathematics, chemistry, and geology through second year because he could not decide whether his future lay in chemistry or

[1]This memoir draws on information in the transcript of the interview with Woodall conducted by Professor Richard Stanton for the Australian Academy of Science in 2008: Stanton (2008). Readers may also wish to consult the transcript of interviews conducted in 2004 for the Regional Oral History Office of the Bancroft Library at the University of California, Berkeley: Stanton (2008).

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Fig. 1. Roy Woodall (photograph provided by the Australian Academy of Science).

geology. Carrying the extra load of chemistry stood him in good stead because one of Woodall's hallmarks through his career was a deep understanding of geochemistry. Then, to the benefit of our nation, he chose geology, dropped chemistry, won the Edward Sydney Simpson Prize in Geology and shared the Science Union Prize. He graduated fourth year with first class honours in geology in 1953.

To help with finances, during his university vacations he took work with Western Mining Corporation (WMC), a relatively small company with goldmines at Coolgardie, Kalgoorlie and Norseman.[2] This was a fortuitous choice because WMC was serious about using the best possible science in its exploration activities and this obviously resonated deeply with the young Woodall.

He spent his second summer vacation with WMC at Norseman where he was exposed to the work of Haddon King, who had used detailed observations and careful mapping to conclude that extensions to the known ore systems would be to the north of the known ore body and not to the south as commonly believed. Drilling to the north led to the discovery of the remarkable Princess Royal orebody. This rigorous application of science, combined with his admiration for Chief Geologist Don Campbell, convinced the young Woodall that WMC was where he wished to work after graduating.

Despite encouragement from Professor Rex Prider, head of the geology department at UWA, to remain at the university and get a PhD, Woodall went to work for WMC to learn as much as he could about the origin of ore deposits and gained valuable experience at Coolgardie and Kalgoorlie. It was the same year that WMC had decided to apply its limited income from gold mining to diversify into other minerals.

Further education in North America

Woodall began to look at further education options in the United States of America (USA) because he felt that was where the greatest ore deposits were, and where the best ore deposit research was being done. He applied to several universities, among them the University of California Berkeley, which offered many undergraduate scholarships funded by philanthropy. Woodall's letter was forwarded by the university to the English Speaking Union of San Francisco, which had a special interest in supporting students from Australia or New Zealand, and they contacted him directly to offer financial support for his first year. He also had a travel grant from the Fulbright Foundation and an offer of a junior teaching appointment.

In May 1953, Woodall married Barbara Smith, the love of his life, and soon after travelled to Berkeley where he sorted out accommodation so that Barbara could follow later and the young family could be established there. Woodall was always deeply grateful for the kindness of American people, particularly the women of the English Speaking Union, who eased the path for this young and relatively impecunious family—Woodall had to cycle to work while the rich kids he was tutoring drove fancy cars.

Woodall was particularly influenced by two Berkeley professors, Charles Meyer[3] and Ed Wisser,[4] who both had extensive industry experience and deep knowledge of ore deposits. Having completed his master's degree in 1957, Woodall had an important decision to make; to go on to a PhD or return to industry. Meyer strongly advised him to 'go back to Australia and find ore deposits'.[5] He returned to Australia and rejoined WMC, despite the fact that the company was small, the gold price was low, and gold mining was not then very profitable. In the event, he had a long and successful career with the company, and wrote in great detail about it, covering technical details of projects and drawing on his experience to reflect on the need for teamwork and a sense of vision in mineral exploration and discovery.[6]

[2]The Western Mining Corporation was formed in 1933. The company was delisted in 2005 after it was taken over by BHP Billiton. Company records are held at the University of Melbourne and BHP Billiton, but a collection of historical material provided by the company and its employees has been digitised and is accessible at the National Library of Australia, https://nla.gov.au/nla.obj-491956360/findingaid?digitised=y.
[3]Hunt (*n.d.*).
[4]Cloos (*n.d.*).
[5]Stanton (2008).
[6]Woodall (1984*a*, 1984*b*, 1984*c*, 1985, 1994).

WMC and the Darling Ranges bauxite

Some of the highest-grade bauxite deposits in the world (roughly 50% Al_2O_3) had been discovered in northern Queensland and, in 1957, Woodall was asked by the chief geologist of WMC to investigate the little-known bauxite deposits in the Darling Ranges of WA. The only thing Woodall knew about these deposits was how bauxites were formed and that these particular deposits were considered uneconomic because they were low in alumina and high in silica (high reactive silica reduces the efficiency of the refining process and therefore raises the cost). While researching the issue he found a volume written by the Bureau of Mineral Resources (now Geoscience Australia) on bauxite occurrences in Australia, including a short account of what it called the low-grade bauxite deposits in the Darling Ranges.[7] Typical of Woodall, and a hallmark of his career, he noticed an important detail that had been overlooked by others: most of the high silica content was in the form of quartz (which is not very reactive in the refining process) and not in the form of reactive silica clays (which consume caustic soda in the refining process and kill the efficiency). These deposits had been considered uneconomic because the mineralogy had been misunderstood.

WMC proceeded to acquire coverage of more than 16 000 km^2 of the Darling Ranges in eight Temporary Reserves, joined with North Broken Hill and Broken Hill South to explore and assess these deposits, before joining with the Alcoa Corporation of America to develop one of the great alumina sources in the world. It later turned out that the alumina mineral in the WA bauxites was gibbsite, an alumina mineral that dissolves at a relatively low temperature thereby decreasing the cost of refining. It took Woodall to see it, and, as a result, WMC became the lowest-cost producer of alumina in the world despite having the lowest grade bauxite of any commercial-scale operations in the world (around 27–30% Al_2O_3).

The Kambalda nickel revolution

Diversification by WMC, no doubt influenced by Woodall, also led to copper exploration on the Yampi Peninsula in the Kimberley and the old Moonta field in South Australia, and to iron ore exploration in the Central Western Region of WA. The iron ore exploration led to development of the small deposit at Morawa (in partnership with Hanna and Homestake from the USA) and the first iron ore exports from WA.

The WMC main office was right by the great Kalgoorlie Golden Mile gold deposits. The goldfield had been carefully mapped in 1933, providing valuable structural information, and subsequently had been the subject of much outstanding geological study. In the early 1960s, Woodall was asked to remap the goldfield. Working with Guy Travis, a newly recruited young geologist, he made significant advances in geological understanding of the region. In particular he was able to show that one dolerite and one basalt horizon were particularly favourable for gold and this led to an increased ability to target exploration into areas of special significance.[8]

Although they managed to intersect a narrow vein of high-grade telluride mineralisation, it was at a depth of more than a kilometre; with gold only $35 an ounce, further exploration was not worthwhile. In the meantime, detailed mapping continued southwards from Kalgoorlie in the search for other deposits.

In the late 1890s, prospectors had found gold on the north shore of Lake Lefroy, about 60 km south of Kalgoorlie, and established a small, profitable mine at Red Hill. In the 1930s, this led to other gold prospectors exploring the region and at one nearby spot they dug holes into an ironstone outcrop that lacked significant gold but showed some green staining. Heightened interest in uranium in the 1950s led to one of these prospectors returning to sample the ironstone to see if the green staining might indicate uranium. These samples were analysed at the Kalgoorlie School of Mines and, whilst they were negative for uranium, they contained about 1% nickel that was of little commercial interest at the time. However, in 1964, the same prospector learnt that WMC was interested in base metals and samples of the same ironstone were submitted to Woodall.

He sent the sample off to the new emissions spectrograph capability in Adelaide and the report came back that the sample contained low-grade nickel and copper but unusually high amounts of silver, tellurium and molybdenum. This intrigued Woodall, and to understand it better he turned to the recently published *Goldschmidt's Geochemistry*[9] that he had purchased on the strong recommendation of Charles Meyer. Woodall had known that silver and tellurium occurred in gold ores but was surprised to read they were also present in significant amounts in a nickel sulfide. He also read that molybdenite was sometimes found in a genetic relationship with norites (particular kinds of gabbro); critically, Woodall knew that norites were associated with the great Canadian nickel sulfide deposits.

Woodall came to the (then) controversial view that this ironstone outcrop was coming from an iron–nickel–copper–sulfide vein that had precipitated out of classic mafic or ultramafic rocks in Archaean rocks. He had understood and identified a new type of deposit, now known as a 'Kambalda-type komatiitic nickel ore deposit', a class of magmatic iron–nickel–copper–platinum-group-element ore deposits formed by the physical processes of komatiite

[7] Owen (1954) pp. 144–147.
[8] Woodall (1965). Travis and others (1971).
[9] Goldschmidt (1958).

volcanology depositing, concentrating and enriching a Fe–Ni–Cu–(PGE) sulfide melt within the lava flow environment of an erupting komatiite volcano.

Woodall obtained permission to map the area, known as 'Red Hill', over the summer of 1964–5 using Guy Travis and two university students. During the mapping they discovered an old abandoned townsite called Kambalda and thereafter 'Red Hill' was known as Kambalda.

Woodall was convinced they had identified several locations worth the expense of drilling to identify the nickel grade but geologists from major companies were unimpressed. He pleaded with head office WMC for funding but was met with significant scepticism, based essentially on the history of 70 years of prospecting with only gold found; furthermore, no one had ever found nickel ores in Archaean rocks. He did, however, manage to get some support at senior levels in the company and was provided a small budget to drill six short diamond-drill holes.

On the first hole the team intersected nickel sulfides assaying at 8.3% nickel; a remarkably high grade of nickel ore. But then, as is so often the case in exploration, the next five holes showed nothing. 'It is interesting to speculate what might have happened if these subsequent barren holes had been drilled first', Woodall wrote, 'bearing in mind that this drilling was being carried out in an environment yet to be proved as favourable for major nickel sulfide occurrences'.[10] By then Woodall had enough information to work out the trend of the nickel sulfide ore and thereafter they were able to drill a series of successful holes showing a very high-grade nickel ore.

Kambalda became the site of the first nickel sulfides in the world found in Archaean rocks and it started the great West Australian nickel boom. Nickel sulfide deposits were discovered all through the country to the south of Kalgoorlie and then found well north, up towards Wiluna in the northern part of the goldfields. Within 18 months, in 1967, WMC commenced production and became a major mining company. A great new Australian industry was created, rivalling the great nickel deposits of Canada, and continues to this day.

Woodall regarded this discovery as a classic case of how the careful application of science can lead to a discovery, and he later commented that finding nickel at Kambalda helped him to make a very significant contribution to Australia and the Australian people, which was always what he wanted to do.

Uranium

In 1967, Woodall was promoted to chief geologist, then to exploration manager leading a growing Exploration Division with a substantial exploration budget; his team's sights were set on not only nickel and gold, but also on uranium.

Significant uranium mineralisation was known in the USA, occurring where fluids had moved down through sandstone, leaching uranium and re-depositing it below in enrichments. Following this model, Woodall and Eric Cameron thought the ancient Tertiary river channels in Western Australia, now filled in and occupied by salt lakes, might be good traps for enrichment of uranium eroded from the plentiful uranium bearing basement granites. This proved to be the case and the mineral carnotite (a potassium, vanadium, uranium oxide) was discovered in the buried river gravels at Yeelirrie. This was the first discovery of this type of uranium deposit, displaying again the effectiveness of Woodall's application of science. The resource is estimated to contain 52 500 t U_3O_8 but was not mined at that time because of Australian Government restrictions.[11]

Olympic Dam

Ever since he had returned to Australia from Berkeley, Woodall had been determined to find a major copper deposit for WMC. He and his team had four major copper exploration campaigns 1960–70: in the west Kimberley in WA, the Adelaide fold belt in South Australia (SA), the Fortescue project in the Pilbara, and the Warburton Ranges of eastern WA. Disappointingly, none of these four campaigns was successful in finding a major copper deposit for the company.

However, working with the Aboriginal community,[12] the team did find some small, rich, discrete copper veins in the Warburton Range region that assayed 60% copper and 60 ounces of silver to the tonne. For two years, in partnership with the Aborigines and a mining party from Kalgoorlie, they mined those veins and split the profits three ways: one-third to the Aborigines; one-third to Western Mining, which had provided all the equipment; and one-third to the four-man mining party that did a lot of the mining and helped the Aborigines learn about mining. This was typical Woodall.

Then came the crowning success in Woodall's career. For this campaign Woodall had decided a focused scientific approach was needed. He had previously sent a WMC geologist, Douglas Haynes, off to the Australian National University (ANU) to do a PhD, and Haynes had developed a model for the extraction and concentration of copper from basaltic source rocks as one of the best processes to form a major copper deposit. Woodall and Haynes decided to search for large volumes of mafic rock—iron-magnesium-rich rock—in which the magnetite had been oxidised to

[10] Woodall and Travis (1970).

[11] The mine is now owned and operated by Cameco Corp. which estimates the resource to contain 128.1 million pounds (58,105 tonne) of U_3O_8. https://www.camecoaustralia.com/projects/yeelirrie, viewed March 2023.

[12] The Warburton Ranges (Mirlirrtjarra) Community is in the Ngaanyatjarra Lands of the Gibson Desert region of Western Australia. https://www.ngaanyatjarraku-wa.gov.au/our-region/our-communities/arburton-milyirrtjarra-aspx, viewed March 2023.

hematite and the copper released to become an ore-forming solution which, if near the right plumbing system, might precipitate and form an orebody; but where? They chose SA because the state government was promising an excellent geological survey that had good coverage of geological and geophysical maps, and there had been early copper mining around Moonta and Wallaroo.

Again, typical of Woodall, he recognised that to apply the known science effectively he needed a multidisciplinary team to get a full understanding of the geochemistry, geophysics, geology, petrology, and structure. This led to collaboration with Douglas Haynes, Hugh Rutter, Dan Evans, Jim Lalor, Geoffrey Hudson and Tim O'Driscoll. Based on the science, particularly the coincidence of geophysics (magnetic and gravity anomalies) and deep structure, they identified several structural targets.

The first target drilled was close to the only distinguishing feature in that desert area; a cattle watering hole dug out by a pastoralist to catch rainwater for his cattle. He had excavated the dam at the same time as the 1956 Olympic Games were being held in Melbourne, so he called it the 'Olympic Dam'; thus was born Olympic Dam target project!

The first hole drilled, RD1 in 1975, intersected a highly fractured very strange hematite-rich rock under 300 m of cover. The assay showed about 1% copper as very fine bornite. As so often happens in exploration, holes two through nine showed nothing of value. But persistence paid off and RD10 intersected 200 m of 2% copper with significant gold and uranium. Olympic Dam had been discovered! This is the world's greatest known concentrations of copper, uranium and gold deposit at total minerals resources of 10.4 billion tonne at 0.77% Cu, 250 ppm U_3O_8, 0.5 g/t Au, and 6 g/t Ag. It is the fourth largest copper deposit and the largest known single deposit of uranium in the world and was the foundation of a new class of ore deposit termed 'iron–oxide copper–gold'.

Woodall wrote thoughtfully about 'blind orebodies', invoking the power of multidisciplinary teams, the use of exploration models, the willingness to drill 'wildcat' holes and most importantly the development of concepts or theories that pose 'greater uncertainties and risks' but 'may lead to the discovery of previously unknown ore deposit types'.[13] As anyone involved in exploration knows, to discover a viable deposit under such a depth of cover is simply astounding.

Petroleum

Woodall was also instrumental in the formation of WMC's Petroleum Division in the early 1970s where he was able to instill a similar scientific culture coupled with innovation and multidisciplinary teams. WMC's petroleum operations covered many regions of Australia plus New Zealand, Malaysia, and the USA over its short 26-year life. This led to many commercial discoveries in Australia primarily in the offshore Carnarvon Basin, WA, resulting in the Airlie Oil Project (South Pepper, North Herald, Chervil) and Thevenard Oil Project (Saladin, Roller, Skate).

Also in the Carnarvon Basin, WMC discovered the East Spar gas field; a key discovery that led to the initiation of the Gold Field Gas Transmission pipeline, a core piece of infrastructure that continues to expand, servicing the mining areas of central WA. Innovation and low-cost developments were prominent in these projects. In the onshore Cooper and Surat Basins, WMC also participated in many oil and gas discoveries.

Woodall initiated WMC's expansion into the US petroleum business in the late 1980s where the company teamed up with experienced US scientists and engineers to develop a successful petroleum acquisition and production company called Greenhill Petroleum Corporation (GPC), a wholly owned subsidiary of WMC. GPC's focus was on the oil fields of the Permian Basin (West Texas/New Mexico) and the onshore Gulf Coast (Louisiana/Texas). GPC was sold by WMC to MESA Inc in 1997, which simultaneously merged with Parker and Parsley to form the current large US independent Pioneer Natural Resources.

Not only did Woodall leave a legacy of projects: many young petroleum geoscientists and new graduates got their career starts in WMC's Petroleum Division. Learning their trade in the offshore North West Shelf, onshore Cooper, Canning, Surat, Otway Basins and ventures overseas many then went on to more distinguished positions in the industry. Woodall always voiced that 'small seeds can lead to large trees',[14] and this was demonstrated in the short history of the Petroleum Division.

Gold

The interest of Western Mining and of Woodall in gold mineralisation, beginning in the Kalgoorlie area, was mentioned above, in connection with nickel at Kambalda.[15] In fact, as you might expect for a leading Australian exploration geologist, Woodall soon became an expert in gold and made frequent contributions on this subject in conferences and monographs. In 1975, he took a broader canvas, the Precambrian shield of Western Australia,[16] and in 1979 the publication text of the presentation he had made

[13] Woodall (1993).
[14] This appears to be an abridged version of the statement by the Melbourne Mining Club that appears on the website of their Cutting Edge forums at which small to mid-cap exploration and development companies showcase their activities. https://www.melbourneminingclub.com/events/cuting-edge/, viewed January 2023.
[15] Woodall (1965). Travis and others (1971).
[16] Woodall (1975).

the previous year at a gold mineralisation conference held at the University of Western Australia was of textbook quality, with extensive references and diagrams.[17]

The last of his 'gold' papers was a contribution to a monograph published by the Australasian Institute of Mining and Metallurgy in 1990 that several of his Western Mining colleagues had been involved in.[18] He provided statistics for gold production at Australian mines up to 1987, and wrote about his scientific approach to exploration with the words: 'Not only are the problems of gold deposit formation scientifically challenging, their solution is critical to our understanding of why gold deposits form, and thus to the development of more reliable exploration strategies, and more effective exploration'.

Personal life, honours and awards

Woodall was unique in that his exploration vision, expertise and leadership led to so many mineral discoveries, three of which were the first in a new class of economic ore deposit and in that so many of his protégés have been remarkably successful as well. Determined to have the right people, he never delegated recruitment to his team, and frequently visited universities to give talks, conduct interviews and recruit the best students to WMC.[19] Over his 40 years of running WMC exploration, thirty or forty of his staff went to universities all over the world to make sure that they kept up-to-date, and that they brought back new ideas all the time. Woodall was fiercely loyal to his quality staff and they stayed with him because they were being treated well and knew they were working for a top scientific exploration team (Fig. 2).

Whilst devoted to exploration, and deeply committed to WMC, Woodall also loved a good time when the opportunity arose. Unbounded enthusiasm combined with a mischievous, and occasionally outrageous, sense of humour led to some lively staff parties in Kalgoorlie hosted by the Woodalls, at which men's neckties sometimes fell victim to his scissors. The 1965 suggestion of an annual dinner for WMC geological staff was immediately embraced by him with awards created and honorary doctorates presented. The highlight was Woodall's presentations at the Geological Dinners of the WMC Exploration Division of the Crackpot Award (an award that endured for over 20 years) for 'Dynamic Incompetence; Brilliant Misconception; and Distinguished Obscurity'.[20] Woodall was also instinctively competitive, be it fishing, on the squash court, growing mushrooms at home, or playing darts in the Widgiemooltha and Leonora pub during overnight visits to prospects.

Fig. 2. Woodall in mid-career (photograph supplied by Woodall family).

Woodall's wife, Barbara, made a significant contribution to both his personal and professional life. To quote him: 'She is as much an owner of many of those discoveries as anybody'; an extraordinary statement testifying to her remarkable contribution. Between them they brought up ten children and, to quote him again 'we knew we could afford to house them, clothe them, feed them, educate them and love them'.[21] As a result: 'the Woodalls have given Australia three engineers, a doctor, a very talented botanist, two wonderful mothers, a young woman and two other sons, who are very talented in the world of finance and business'.[22] What a difference from the circumstances of his own youth.

Woodall was appointed Director of Exploration for WMC in 1978 and over his career received significant external recognition through medals and honours. The medals he was awarded include the William Smith Medal of the Geological Society of London (1983), the Mawson Medal of the Australian Academy of Science (1984), the Mueller Medal of the Australian and New Zealand Association for the Advancement of Science (1985), the Silver Medal of the Society of Economic Geologists (1986), the William Lawrence Saunders Gold Medal of the American Institute

[17] Woodall (1979).
[18] Woodall (1990).
[19] Hill and others (2020).
[20] Ralph (~1995).
[21] Stanton (2008).
[22] Hill and others (2020).

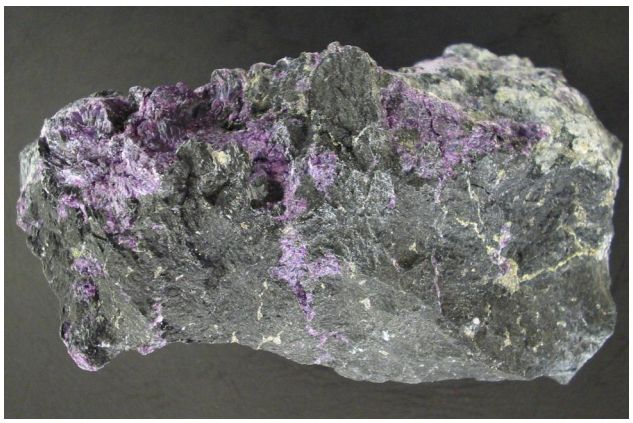

Fig. 3. Woodallite from Mount Keith open pit, Wiluna Shire, Western Australia (photograph provided by Dr Ben Grguric).

of Mining Engineers (1988), the Clunies Ross National Science and Technology Award (1993), the Ian Wark Medal of the Australian Academy of Science (1996), the Haddon Forrester King Medal of the Australian Academy of Science (1993), the Clunies Ross Science and Technology Lifetime Service Award of the Australian Academy of Technological Sciences and Engineering (2011), and the Centenary Medal for service to Australian society and science (2001). UWA conferred an honorary Doctor of Science degree on Woodall in 1985. In 2000, a rare chromium mineral ($Mg_6Cr_2(OH)_{16}Cl_2{\cdot}4H_2O$) found in the Mount Keith open pit mine in Wiluna Shire, Western Australia, was named Woodallite (Fig. 3).[23] Writing to thank the discoverer for his kindness in naming the new mineral, Woodall wrote: 'it is encouraging to me to know that persons of your calibre are still employed by WMC and allowed sufficient freedom of thought and action to remain effective scientists'.[24]

In 2020, the Australian Geoscience Council created the Roy Woodall Medal to recognise scientific excellence in both mineral exploration and the documentation of world-class mineral deposits. The 'award honours the extensive contribution to scientific excellence in Mineral Geoscience that the late Roy Woodall AO made over his lifetime. Roy Woodall's high scientific standards, innovative approach to exploration and use of the latest geoscientific techniques have left an enormous and lasting legacy of improved scientific methodologies and exploration successes'.[25] Fittingly, the first recipient of this award was Kathy Ehrig, a protégé of Woodall, who wrote in her obituary of Woodall: 'Roy was my mentor and provided me with unswerving support for the past thirty years. … I am a better scientist and person because of Roy'.[26]

In recognition of his scientific excellence and overall contribution to Australia, Woodall was elected a Fellow of the Australian Academy of Technological Sciences and Engineering in 1977, a Fellow of the Australian Academy of Science in 1988, and in 1981 he was appointed an Officer of the Order of Australia (AO) for service to the mining industry.

Woodall always wanted to make a difference by helping people to be more prosperous. As one of the 'mineral exploration scientists and the technicians who support them', he wrote, that for the best, 'their motivation to succeed goes far beyond the thoughts of financial gain'. In this vein he concluded his address upon receiving the Ian Wark medal of the Australian Academy of Science by quoting from Longfellow's *Song of Hiawatha*, who worked not for 'renown among the warriors | But for profit of the people | For advantage of the nations.'[27] From humble beginnings, Woodall achieved this in outstanding measure.

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[23] Grguric and others (2018).
[24] Letter, R. Woodall to Dr Ben Grguric, 30 January 2001.
[25] https://www.agc.org.au/geoscience-in-australia/roy-woodall-medal/, viewed January 2023.
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