Tribute to Eric Raymond (Lou) Vance (15th November, 1942–7th March, 2019)

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Eric Raymond Vance, known as Lou to almost all of his friends and colleagues, was born in Ararat but during his childhood the family moved to Stawell where his father, Albert Louis Vance, established a pharmacy business. From his commencement at Stawell High School, (now known as Stawell Secondary College), it was very soon apparent that Lou was a person of exceptional abilities. He had a remarkable capacity for scholastic achievement, exhibiting from the early years sharp insight, industry and unusual inventiveness. He scored outstanding results at all levels through these years, culminating in First-Class Honours in all subjects and four General Exhibitions in his Matriculation in 1959. To this day, the college authorities consider Eric Raymond Vance to have been one of their most talented students and a special award now given annually to the brightest science student, is named in his honour¹.

Lou was also a most competitive sportsman, excelling in football, cricket, tennis and golf in his youth but settling for the last two in his later years. His golfing friends from his young days remember him being equally skilled on a golf course, either right-handed or left-handed, depending on the availability of either his sister's clubs (right-handed) or his father's clubs (left-handed) but he remained left-handed for his personal clubs. Lou was also a very keen bridge player

and he and his wife, Jan, spent a lot of time playing bridge during the winters while they were living in Canada.

Following a B.Sc. from The University of Melbourne, Lou graduated with a Ph.D. in Physics from Monash University in 1968, with a thesis entitled “A Study of Gamma Manganese and Some of its Alloys” for which he researched the antiferromagnetism in manganese alloys, under the supervision of the late Associate Professor Jack Smith. He then held research positions around the world, summarised as follows:

1968–1969: Australian Atomic Energy Commission, (now ANSTO), Sydney, during which time he not only published papers from his thesis but continued to undertake neutron scattering studies on metal alloys and oxides;

1969–1972: University College, London, England, where he was a Research Associate in the group of Dr Judith Milledge, researching irradiation effects on minerals and, in particular, diamonds;

1972–1977: Research School of Physical Sciences, Australian National University, Canberra, where he was a Research Fellow in the Department chaired by Professor Alan Runciman, and which for Lou was a most productive period in his research on irradiation effects in various minerals;

1977–1978: University College, London — a return to the research on irradiation effects in minerals in the group of Dr Judith Milledge;

1978–1979: Research Associate, Georgia State University, Atlanta, GA, USA, which not only involved his introduction to positron annihilation, a technique he would use on projects later in his career, but also a return to manganese alloy research [1];

1979–1982: Senior Research Associate, Materials Research Laboratory, Pennsylvania State University, State College, PA, USA — a most productive time in his research career, during which he worked in the group of the late Professor Rustum Roy and which gave him his initial introduction to nuclear waste technology;

1982–1987: Research Scientist, Atomic Energy of Canada Ltd., Pinawa, Manitoba, Canada, involving studies on

¹ “Dr Eric ‘Lou’ Vance Memorial Award”. (Any reader who would like to donate to the fund, which has been established to maintain this award into the future, is welcome to make a contribution either by sending a cheque to: The Principal, Stawell Secondary College, P.O. Box 202, Stawell, Victoria. 3380; or by making a direct deposit to: Dr Eric “Lou” Vance Memorial Award, BSB: 063528 A/C No.: 10009073).

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Fig. 1 ANSTO Synroc Team 2018 (L→R): Gerry Triani, Jim Chapman, Dan Gregg, Jesse Jones, Lou Vance, Sean Brophy, Ian Watson, Mitchell Smith, Amanda Abboud, Stephen Deen, Greg Hall, Bryan Blaney, Mile Miladinovski, Rohan Holmes (Image courtesy of Gerry Triani, ANSTO, 2018)

sphe-ne and sphe-ne-based glass-ceramics for high-level nuclear waste and spent fuel;

1987–2019: ANSTO, Sydney, to which he was recruited specifically to undertake research on Synroc, but, in typical “Lou Vance style”, not limited to this topic.

In 2007, Lou received a Leverhulme Fellowship which enabled him to work with Professor Ian Farnon in Earth Sciences at Cambridge University in 2008. Lou was later made a Life Member of Clare Hall.

Lou’s research embraced many different areas of the physics of materials, and included not only ceramics, but studies of magnetism in metallic alloys, neutron irradiation effects in diamonds and other minerals, properties of glass-ceramics and geopolymers. Surprisingly, his first-ever refereed publication was not on his own PhD thesis topic but on what was then (1968) considered to be a “high-temperature superconducting material”, the A15- structure compound, V_3Si [2]. Lou briefly returned to research on superconducting materials, following the discovery of high- T_c ceramics [3], for which Lou’s experience in ceramic processing appealed to his collaborators.

But, as indicated above, Lou’s recruitment to ANSTO followed the invention of Synroc, in the 1970s, by the late Professor Ted Ringwood of the Australian National University [4]. Synroc, a synthetic mineral for safely locking away various radioactive elements, subsequently occupied much of the research effort for Lou and his ANSTO colleagues (Figure 1) for the remainder of his life. Drawing on his knowledge of waste-form technology from his research in Canada, and enthusiastically applying this to the Synroc programme, Lou progressed within ANSTO, being promoted to Senior Research Scientist in 1987 and to Chief Research Scientist in 2001.

He was author or co-author of almost 400 articles in international journals and conference proceedings. His most cited publication [5] has 953 citations, according to *Google Scholar* at the date of preparation of this Tribute article and ten of his publications have been cited in excess of 100 times. He was also co-author on three patents.

He was a Fellow of the Australian Ceramic Society, the Australian Institute of Physics, the American Ceramic Society and the Australian Academy of Technological Sciences and Engineering. Lou was also an Academician of the World Academy of Ceramics, a long-time member of the Materials Research Society and a member of the Australian Nuclear Association. He held editorial and/or advisory board roles for the *Journal of the Australian Ceramic Society*, the *Journal of Nuclear Materials*, the *Journal of the American Ceramic Society* and the *Journal of Nuclear Science and Technology*. Lou also served on numerous international ceramic conference organising committees and was a frequent session chair at radioactive waste immobilisation symposia. He was lead organiser for the symposium on radioactive waste immobilisation at PacRim 6 (Maui, 2005) and technical organiser of the Austceram arm for Materials Australia/Austceram 07 (Sydney, 2007). He was also co-technical organiser for PacRim 9 (Cairns, 2011) and the Materials Research Society’s “Scientific basis for Nuclear Waste Management” Symposium held in Sydney in 2017. He was a keen supporter of the annual Australian and New Zealand Condensed Matter and Materials Conference (colloquially known as “Wagga”) (Figure 2), and contributed on many occasions to the regular conferences of Materials Australia/Austceram and to the publication of the Australian Ceramic Society. In Table 1, his scientific inputs

Fig. 2 “Distinguished Gentlemen”, ((L→R): Neil Manson, Lou Vance, Jaan Oitmaa, Trevor Finlayson (Quiz Master), Stewart Campbell, Sean Cadogan, Stephen Collocott, Glen Stewart and Chris Hamer) accept the Lindsay Davis Cup for their win in the Trivia Quiz during “Wagga” 2013 (Picture courtesy CMM website, (cmm-group.com.au/wagga-2013))

to “Waggas” from 1989 to 2018 are listed and, in this special Tribute for the *Journal of the Australian Ceramic Society (JACS)*, the 13 papers which he has authored or co-authored in the Society’s journal between 1997 and 2016 are summarised. For each publication, the title and authorship and, to the best of the authors’ ability, the background to the paper and Lou’s personal contribution to the research in question are given. Lou was also a co-editor of *JACS* (with Professor Bessim Ben-Nissan) from 2001 to 2016, at which time the Society chose to transfer its journal to Springer as an electronic one, as has been explained in a final Editorial [6].

It should be pointed out that two Tributes to Dr Lou Vance have already been published and each of these contained the details of his early life and his outstanding research career, as are summarised in this Tribute. The first of these [7] was published in *Australian Physics*, the “house journal” of the Australian Institute of Physics of which Lou was a Fellow. The second [8] was the Guest Editorial for a Special Tribute Issue of the *Journal of the American Ceramic Society* which consisted of 12 original papers in areas of ceramics research in which Dr Vance had worked during his career, together with a major review of Synroc technology [9].

In 2018, Lou was awarded the prestigious ANSTO CEO Award, jointly with the late Dr Mark Reinhard, for his sustained research contribution. It is a measure of his scientific leadership and achievements within the Synroc programme that a first-of-a-kind, industrial-scale, Synroc

waste treatment facility has been constructed on the ANSTO site at Lucas Heights [10].

Lou leaves behind a legacy in terms of his science but also his attitude and approach to life. His knowledge and his discoveries will be taken forward by his ANSTO and international colleagues who will forever remember his warmth, his generosity, his humour and his humility.

Lou is survived by his wife, Jan, of almost 50 years, his children, Julia and Michael, and his four grandchildren, Ben and Anna, Lucy and Sophie.

Summary of papers authored or co-authored in *J. Aust. Ceram. Soc.* by Lou Vance

In this summary, the contributions by Lou Vance to the Australian Ceramic Society journal, in addition to his having been a co-editor from 2001 to 2016, are summarised. The aim with the list is to summarise the significant finding(s) in each publication. To the best of the authors’ knowledge, the publication is placed in context and the particular personal contributions by Lou to the published work are indicated.

Paper 1

“Comparative Study of SYNROC Consolidation Methods”, M.W.A. Stewart, M.L. Carter, S. Moricca, D.S. Perera and E.R. Vance, *J. Aust. Ceram. Soc.* **33** (1/2) 43–50 (1997).

Table 1 Contributions to the annual Australian and New Zealand Condensed Matter and Materials Conferences (“Wagga”) by Lou Vance. The presenting author is underlined

1989	<i>Redox Control in Synroc Fabrication</i> <u>E.R. Vance</u> <i>Formation of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Precursor Powder and Fibres from Metal Acetate Solutions</i> <u>M.J. Baker</u> and E.R. Vance
1990	<i>Crystal Chemistry and Phase Manipulation in Synroc</i> <u>E.R. Vance</u> and S. Moricca <i>Fabrication Process for Ceramic High T_c Superconductors</i> <u>J. Argyriou</u> and E.R. Vance
1991	<i>X-Ray and Neutron Diffraction Studies of Metastable Ca-Ti Oxides</i> <u>E.R. Vance</u> and R.L. Davis <i>Crystallization of Akermanite and Merwinite from Glass and Gel Precursors</i> <u>E.R. Vance</u> , R.A. Day and D.J. Cassidy
1993	<i>Charge Compensation for Gd^{3+} in Perovskite CaTiO_3</i> <u>E.R. Vance</u> , B.D. Begg, R.A. Day and C.J. Ball <i>Incorporation of Rare Earths and Actinides in Zirconolite, $\text{CaZrTi}_2\text{O}_7$</i> C.J. Ball, E.R. Vance and <u>B.D. Begg</u>
1994	<i>Cell Parameters and the Orthorhombic to Cubic Transformation in Strontium Substituted Perovskite (CaTiO_3)</i> C.J. Ball, <u>B.D. Begg</u> and E.R. Vance <i>Charge Compensation Mechanisms for Aliovalent Impurities in Perovskite and Zirconolite</i> <u>E.R. Vance</u> , R.A. Day, B.D. Begg and M.G. Blackford
1995	<i>X-Ray Diffraction from $(\text{Sr,Ca})\text{TiO}_3$</i> C.J. Ball, <u>E.R. Vance</u> , B.D. Begg and D.J. Cassidy <i>Effect of Powder Particle Size on the Properties of Bi2223 Superconducting Bulk and Tapes</i> <u>M. Yavuz</u> , H.K. Liu, Y.C. Guo, E.R. Vance and S.X. Dou
1996	<i>Particle and Powder Characterisation of Bi-based Superconductors</i> <u>M. Yavuz</u> , Y.C. Guo, E.R. Vance, H.L. Liu and S.X. Dou <i>XAS Study of Pu and Np Incorporation in Zirconolite</i> <u>B.D. Begg</u> and E.R. Vance <i>Leaching of Synroc in D_2O</i> <u>E.R. Vance</u> , N. Dytlewski, B.D. Begg, K. Prince and G.J. Thorogood
1998	<i>Charge Compensation of Rare Earths on Ca Site in Zirconolite, $\text{CaZrTi}_2\text{O}_7$, and Ca/SrTiO_3 Perovskites</i> J.H. Hadley Jr, F.H. Hsu, Yong Hu, V. Bellito, <u>E.R. Vance</u> and B.D. Begg <i>Charge Compensation and the Incorporation of Cerium in Zirconolite and Perovskite</i> <u>B.D. Begg</u> , E.R. Vance and G.R. Lumpkin
1999	<i>Crystal Chemistry and Synthesis of Pyrochlore Structured CaATi_2O_7 and Brannerite, ATi_2O_6 ($A = \text{Ce, U, Th, Pu}$) Phases for Pu Immobilisation</i> <u>E.R. Vance</u> , M.L. Carter, J.N. Watson, R.A. Day and S. Leung
2000	<i>The Synthesis and Crystal Structure of Doped U- and Th-Brannerite Phases $(\text{U/Th})_{1-x}\text{MxTi}_2\text{O}_6$ ($M = \text{Ca}^{2+}, \text{La}^{3+}, \text{Gd}^{3+}$ and Y^{3+})</i> M. James, J.N. Watson and <u>E.R. Vance</u> <i>Cation Vacancies and Structures of 4M Zirconolite and Defect Titanate Pyrochlores</i> <u>E.R. Vance</u> , K.L. Smith, G.R. Lumpkin, B.D. Begg and J.H. Hadley Jr.
2002	<i>U and Pu Valences in Crystalline Phases in Candidate Nuclear Wasteforms</i> <u>E.R. Vance</u> , M.L. Carter, K.S. Finnie, B.D. Begg, M.W. Stewart, R.A. Day, Z. Zhang and S.J. Thomson
2003	<i>Geopolymers for Radioactive Waste Immobilisation</i> <u>E.R. Vance</u> , D.S. Perera, Z. Aly, J. Hanna, K.S. Finnie, R.L. Trautman, M.W.A. Stewart and C.L. Dickson <i>Temperature Dependence of Young’s Modulus for $\text{Ca}_{1-x}\text{Sr}_x\text{TiO}_3$ Perovskite Structures</i> <u>J.E. Daniels</u> , T.R. Finlayson, B.A. Latella, T. Liu, S.J. Thomson and E.R. Vance
2004	<i>Phase Transformations in the $\text{Ca}_{1-x}\text{Sr}_x\text{TiO}_3$ Perovskite System</i> <u>J.E. Daniels</u> , M.M. Elcombe, T.R. Finlayson and E.R. Vance <i>Fe and Mg Solubility in the Ca Site of Zirconolite, $\text{CaZrTi}_2\text{O}_7$</i> <u>E.R. Vance</u> , J.D. Cashion, J.V. Hanna, Z. Garrett and M. Bhati
2006	<i>Positron Annihilation Lifetime Spectroscopy on Cation Vacancies in Synroc Minerals-Perovskite, Zirconolite and Pyrochlore Structures</i> <u>E.R. Vance</u> and J.H. Hadley Jr.
2007	<i>Positron Annihilation Lifetime Spectroscopy in Titanate Ceramics</i> <u>E.R. Vance</u> and J.H. Hadley Jr.
2009	<i>What’s Happened to Synroc?</i> <u>E.R. Vance</u> (Invited)
2011	<i>Positron Annihilation Lifetime Spectra of Radiation Damaged, Natural Zircon Crystals</i> J. Roberts, <u>E.R. Vance</u> , J. Sullivan, S. Buckman, J. Davis, P. Gaugliardo, M. Zhang and I. Farnan
2012	<i>Positron Annihilation Lifetime Spectroscopy within CAMS</i> <u>E.R. Vance</u>
2013	<i>U Valences and Site Occupancies in Doped $\text{Gd}_2\text{Zr}_2\text{O}_7$ Pyrochlore-Structured Nuclear Ceramics</i> <u>E.R. Vance</u> , D.J. Gregg, P. Gaugliardo, Y. Zhang, I. Karatchevtseva, G. Griffiths, J. Davis, G.R. Lumpkin and G. Triani
2014	<i>Freudenbergite – a new Example of Electron Hopping</i> <u>J.D. Cashion</u> , A. Lashtabeg, E.R. Vance, D.H. Ryan and S. Solano
2018	<i>Hot Isostatic Pressing of Ceramics, Glass and Glass-Ceramics for Immobilisation of Intermediate- and High-Level Nuclear Waste</i> <u>E.R. Vance</u> , D.J. Gregg and D.T. Chavara

This was a review of the progress towards the production of Synroc C by the various processing methods which had been researched to that time, namely, pressureless sintering, hot-uniaxial pressing (HUPing), hot isostatic pressing (HIPing), spark plasma sintering and melting. For the

case of HUPing, the paper provided some detailed kinetics for the densification of the ceramic based on a creep model. HIPing appeared to have advantages as a processing route, on account of the higher pressures achieved in the patented dumbbell cannisters used for the process.

Paper 2

“Equilibrium Kinetics of CaTiO_3 ”, T. Bak, J. Nowotny, M. Rekas, C.C. Sorrell and E.R. Vance, *J. Aust. Ceram. Soc.* **34** (1) 41–45 (1998).

This is the first of a series of three papers published in the Society’s journal which resulted from collaborative work with colleagues at the University of New South Wales (UNSW), concerning the properties of the titanates which are one crystalline phase in Synroc. Clearly the use of electrical conductivity measurements, as were available at UNSW, was a most satisfactory method with which to monitor diffusion kinetics for oxygen in CaTiO_3 .

Paper 3

“Effect of Oxygen Partial Pressure on Electrical Conductivity of CaTiO_3 ”, T. Bak, J. Nowotny, M. Rekas, C.C. Sorrell and E.R. Vance, *J. Aust. Ceram. Soc.* **34** (1) 56–59 (1998).

This paper appears to be a sequel to Paper 2 in which again electrical conductivity data have been used to monitor the diffusion of oxygen into CaTiO_3 and Gd-doped CaTiO_3 at the elevated temperature of 1223 K. With variation in conductivity as a function of oxygen partial pressure, it is shown that at low partial pressures, the conductivity is n-type while at higher partial pressures, there is a transition to p-type behaviour, as had been previously reported for BaTiO_3 .

Paper 4

“Effect of Gd on Electrical Conductivity of CaTiO_3 ”, T. Bak, J. Nowotny, M. Rekas, C.C. Sorrell and E.R. Vance, *J. Aust. Ceram. Soc.* **34** (1) 182–186 (1998).

This paper contains some fundamental property data for both CaTiO_3 and the same titanate doped with Gd. As with Papers 2 and 3 above, it evolved from collaborative research between ANSTO and UNSW. The effect of the Gd ion substitution was to enhance the conductivity of the ceramic by about one order of magnitude, although the data as presented are influenced at the lower temperatures (typically less than about 800 K) by the conductivity of the sample holder by comparison with that of the sample. Nevertheless, at temperatures above this, the results for heating and cooling experiments are reproducible and lead to a most satisfactory discussion of the fundamental conduction mechanism as the result of activation energy analysis. The text also mentions that Seebeck coefficients were measured during the research, but no results from these measurements are reported in this publication.

Paper 5

“SYNROC Ceramics for Nuclear Waste Immobilisation”, E.R. Vance, *J. Aust. Ceram. Soc.* **38** (1) 48–52 (2002).

On occasions, Lou would present a review of the research on Synroc at ANSTO to a technical meeting or conference of the Australian Ceramic Society, to Materials Australia or to the annual “Wagga” conference. This paper is the result of one such review in which he traces the developments in Synroc, focussing on the various collaborations with international laboratories for different applications, such as the immobilisation of defence wastes at the Savannah River site in the USA, of the actinide wastes such as Pu, with the Japanese Atomic Energy Research Institute or Lawrence Livermore National Laboratory.

Paper 6

“Immobilisation of Radioactive ^{129}I in a Lead Vanadate Matrix by In-can Hot Isostatic Pressing”, D.S. Perera, B.D. Begg, D.J. Cassidy, R.L. Trautman and E.R. Vance, *J. Aust. Ceram. Soc.* **39** (2) 81–87 (2003).

Lou was always keen to provide solutions for particularly challenging problems and the long-term immobilisation of ^{129}I with its extremely long half-life (1.57×10^7 years) is a good example of this. A common strategy to capture ^{129}I is via adsorption from the gas phase on to Ag-impregnated sorbents such as silica and alumina. However, volatilisation and re-release of the ^{129}I remains a significant concern for such materials during subsequent hot-consolidation to produce dense ceramic nuclear wasteforms for disposal. Lou’s typically novel approach was to include $\text{Pb}_5(\text{VO}_4)_3$ into the composition such that if any ^{129}I was to volatilise during hot-isostatic pressing, it would form $\text{Pb}_5(\text{VO}_4)_3\text{I}$, a stable apatite-structured lead vanadate. The paper demonstrated the compatibility of the system and the effectiveness of $\text{Pb}_5(\text{VO}_4)_3$ for immobilising ^{129}I .

Paper 7

“Near-Equilibrium Processing of Ceramics for Actinide Disposition”, M.W.A. Stewart, E.R. Vance, A. Jostons and B.B. Ebbinghaus, *J. Aust. Ceram. Soc.* **39** (2) 130–148 (2003).

This paper was co-authored by scientists from both ANSTO and Lawrence Livermore National Laboratory and highlights work that was undertaken during the Plutonium Immobilisation Project (PIP) from 1994 to 2000, during which Lou provided scientific leadership. The aim of PIP was to develop a method to safely dispose of ~50 tons of excess US weapons Pu in order to meet the obligations of the arms reduction treaties and a portion of this material was to be immobilised in a wasteform for geological disposal. The paper demonstrated that the baseline ceramic wasteform

compositions designed by Lou and his team, when prepared by alkoxide/nitrate processes, could be considered at equilibrium. Importantly, these compositions provided results similar to samples produced by a more industrial processing “plant-like” oxide-route fabrication process. Improvements in grinding/milling methods were developed in the work and both wet- and dry-ball milling as well as wet- and dry-attrition methods were all shown to be suitable using standard sintering treatments. Importantly, the work demonstrated the technical feasibility of the proposed manufacturing route.

Paper 8

“High Level Nuclear Waste-Progress to Technical Solutions”, E.R. Vance, *J. Aust. Ceram. Soc.* **42** (2) 10–13 (2006).

In this paper Lou addressed the “...supposedly unsolved problem of dealing with...” high-level waste, an issue seen as a large impediment to the construction of more nuclear power stations around the world. Lou discussed the available technical solutions for immobilising the various kinds of high-level waste, including glass, ceramics and glass-ceramics. He also highlighted ANSTO’s achievements in the field and indicated that indeed ANSTO had the best technical solutions to treat a variety of high-level wastes that exist internationally. Lou concluded by stating that the nuclear waste problem was substantially solved, though the decision as to the best engineering solution within the international regulatory frameworks was only to be made.

Paper 9

“Disposition of Fission Products in Inert Matrix Fuels for Plutonium Burning”, M.W.A. Stewart and E.R. Vance, *J. Aust. Ceram. Soc.* **42** (2) 50–66 (2006).

In this paper, a review of inert matrices, which have been used in different countries for nuclear power production, is presented. Then laboratory scale experimental research using a mixed oxide precursor and a simulated fission product solution based on PW-4B waste, to produce various ceramic products via both hot-uniaxial and hot-isostatic pressing, is reported with microstructural results for X-ray diffraction and scanning electron microscopy, all typical of the experimental research for which Lou Vance was known internationally.

Paper 10

“Positron Annihilation Lifetime Spectroscopy of Off-Stoichiometric and Doped $\text{Gd}_2\text{Ti}_2\text{O}_7$ ”, E.R. Vance, J.H. Hadley and F.H. Hsu, *J. Aust. Ceram. Soc.* **44** (1) 53–56 (2008).

As mentioned above, positron annihilation was a technique to which Lou Vance was introduced during his time

as a Research Associate at Georgia State University and it is noteworthy that this paper is co-authored by his colleague from that institution, F.H. Hsu. So it is suspected that it was this colleague who undertook the spectroscopic measurements reported in this paper which contains some research on the pyrochlore ceramic which is the principal Synroc-type ceramic designed for the immobilisation of surplus impure plutonium derived from US and Russian weapons programmes.

Paper 11

“Pelite Waste as a Precursor for Geopolymer Formation”, E.R. Vance, D.S. Perera, P. Imperia, D.J. Cassidy, J. Davis and J.T. Gourley, *J. Aust. Ceram. Soc.* **45** (1) 44–49 (2009).

For a period of time, ANSTO participated in the Cooperative Research Centre (CRC) for Sustainable Resource Processing and Lou’s research on geopolymer materials, of which this paper is typical, took place under the auspices of this CRC. Pelite is an aluminosilicate which was under consideration for the immobilisation of hazardous radioactive waste.

Paper 12

“Progress at ANSTO on SYNROC”, E.R. Vance, M.W.A. Stewart and S.A. Moricca, *J. Aust. Ceram. Soc.* **50** (1) 38–48 (2014).

In this paper, Lou discussed important updates on Synroc Technology since his last review in the journal in 2002 (Paper 5 above). Though the paper provided a comprehensive historical review of the Synroc programme to date, including a range of Synroc derivatives for various high-level nuclear wastes, importantly, the paper discussed three significant aspects:

- (a) the transition of Synroc towards hot-isostatic pressing as processing technology;
- (b) Synroc’s particular emphasis on wastes that are problematic for glass matrices or existing vitrification process technologies; and
- (c) The 2013 Australian Federal Government approval to fund a Synroc Waste Treatment Facility to treat the waste arising from the production of ANSTO’s ^{99}Mo . This would see a first-of-a-kind Synroc plant finally achieve industrial implementation of Synroc Technology.

Lou noted that the biggest challenge for the team had been the requirement to increase engineering design capability and process nuclearisation. Lou also took the opportunity to address an argument commonly directed towards wasteform science. The argument posed suggests that within the entire

waste disposal system (wasteform + engineered repository), the overall uncertainties with respect to radionuclide release to the biosphere are such that the properties of the wasteform are apparently “buried in the noise”. However, he reminded the reader that an optimised wasteform minimises the source term and this is driven by experimentally verifiable data, unlike the detailed properties of the repository.

Paper 13

“Aqueous Leaching of an Industrial Geopolymer”, P. De Silva, J. Downs, K. Olufson, J. Davis, E.R. Vance and G. Johnson, *J. Aust. Ceram. Soc.* **52** (1) 1–6 (2016).

Lou’s interest in geopolymers was sparked due to their potential use for the immobilisation of particularly low-level waste, where they show benefits over more traditional Ordinary Portland Cement-type wasteforms. This paper was co-authored by colleagues from both ANSTO and the Australian Catholic University as well as Rocla Pipeline products, the industrial partner. In this work, Lou studied geopolymer materials from which cemetery crypts were made by Rocla on the industrial scale (thousands of tonnes) and the results were compared with those for metakaolin geopolymers and glasses that he had produced in the laboratory. The aqueous durability results for the “crypt” geopolymer were impressive, with derived leach rates and behaviour at different pH values broadly similar to those observed for metakaolin geopolymers and glasses.

References

1. Spooner, S., Child, H.R., Hsu, F.H., Vance, E.R.: Small-angle neutron scattering and positron annihilation in Mn-Cu alloys. *Phys. Stat. Sol. A – Appl Res* **63**, 31–34 (1981)
2. Vance, E.R., Finlayson, T.R.: The lattice softening in V_3Si . *J. Appl. Phys.* **39**, 1980–1982 (1968)
3. Bednorz, J.G., Müller, K.A.: Possible high Tc superconductivity in the Ba-La-Cu-O system. *Z. für Physik B.* **64**, 189–193 (1986)
4. Ringwood, A.E.: Safe disposal of high level nuclear wastes: a new strategy. ISBN 0708117546, Canberra, Australia, (Australian National University Press, 1978)
5. Weber, W.J., Ewing, R.C., Catlow, C.R.A., Diaz de la Rubia, T., Hobbs, L.W., Kinoshita, C., Matzka, M., Salje, E.K.H., Vance, E.R., Zinkle, S.J.: Radiation effects in crystalline ceramics for the immobilization of high-level nuclear waste and plutonium. *J. Mater. Res.* **13**, 1434–1484 (1998)
6. Ben-Nissan, B., Vance, L.: Editorial. *J. Aust. Ceram. Soc.* **53**, 1–2 (2017)
7. Finlayson, T.R., Gregg, D.G.: Vale Eric Raymond (Lou) Vance (1942–2019). *Aust. Phys.* **56**, 162–163 (2019)
8. Finlayson, T.R., Franks, G.V., Gregg, D.G.: A tribute to Eric Raymond (Lou) Vance: Ceramic materials physicist and nuclear wasteform expert – 15th November, 1942 – 7th March, 2019. *J. Amer. Ceram. Soc.* **103**, 5421–5423 (2020)
9. Gregg, D.G., Farzana, R., Dayal, P., Holmes, R., Triani, G.: Synroc technology: Perspectives and current status (Review). *J. Amer. Ceram. Soc.* **103**, 5424–5441 (2020)
10. [ansto.gov.au/news/new-global-first-of-a-kind-ansto-synroc-facility](https://www.ansto.gov.au/news/new-global-first-of-a-kind-ansto-synroc-facility)

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