



This file contains an edited transcript of an oral history interview of Ted Tyne (TT) conducted by Marina Costelloe (MC) on January 6, 2023. The interview aimed to record some of Ted's recollections as a geophysicist and his observations of developments in geophysics during his working life.

A structured series of questions were prepared before the interview and forwarded to the interviewee to allow the interviewee an opportunity to prepare his responses. The interview was conducted online and later transcribed. The edited transcript has been augmented with additional background to provide context to the discussion points.

Ted has been an active member of the ASEG from the foundation years, serving on an early Federal Executive, Co-convenor with D.W. Emerson & J. Webb of the first ASEG Conference & Exhibition in 1979 and supporting a number of later technical conferences and workshops. Ted was ASEG President 2019 and Co-Chair ASEG Publications.

MC

Well Dr Ted Tyne, thank you for joining me today. My name is Marina Costelloe and I've known you for 30 years. It's hard to believe! It's been a huge honour and pleasure to have you as one of my friends and my mentors and indeed a champion. So, I wanted to thank you for that. And today is all about you. I've got some questions to ask you. I'd like you to take your time in answering.

I am joining you today from Geoscience Australia in Canberra. I pay my respects to the Ngunnawal people, the traditional custodians of the lands on which I'm meeting with you today. I pay my respects to their elders, past, present and emerging and note that the Aboriginal and Torres Strait Islanders were the first scientists, the first mappers, the first

explorers of our continent. I also pay my respects to any First Nations people who log on to watch our video today.

Question 1. Ted, would you give us a brief summary of your work history?

TT Thank you Marina! I'm meeting with you from Sydney - I would also like to add my acknowledgement of indigenous communities and peoples and pay my respects to the Gadigal people of this land.

Ahead of talking about my work history, I should reflect on my early formative years. As a young boy and teenager, I had some great mentors and teachers and some wonderful learning experiences which were really profoundly important in guiding me into earth science. My father worked in industrial chemistry and encouraged my early interest in chemistry in my primary school years. I recall some big spills of chemicals on the carpet at home – my mother was very forgiving.

In high school, I had some amazing teachers in my senior years. My Orange High School science master was passionate about geology and he introduced me and several other students in the final two years to field mapping and the excitement of fossil hunting and walking over mineral gossans in the Lachlan Fold Belt. One of the trips I vividly remember was walking over the iron-rich gossan at the old Cadia iron ore mine, the site of the current Cadia Valley Cu-Au operations.

These experiences were influential in my choice of subjects in my UNSW undergraduate years. In my second year, I had a class with Professor Larry Hawkins on earthquake and engineering seismology and exploration geophysics. I'd already had a huge love for physics and geology and maths – the exposure to “geophysics” captured my attention.

So, I chose to major in physics and geology for my Science degree and Laric was a key teacher and mentor for the geophysics stream. At graduation, Laric recommended me to John Ringis, head of the Geophysics Branch in the Geological Survey of NSW (GSNSW) for a vacant geophysicist position. I was passionate for a job in geophysics, starting 1971.

I gained broad experience in all aspects of mineral, coal and petroleum exploration geophysics, with a stronger focus on electrical, electromagnetic and potential field methods. I led the coordination of annual geophysical field camps in the early 1970s for undergraduate students at each of the Sydney universities - regular events for the following 20 years. During the mid 1980s I took up a geophysics teaching role at University of NSW, on partial secondment from the GSNSW, also completing a PhD supervised by Laric and Ifti Qureshi (Supported by GSNSW and Australian Mineral Industries Research Association Title: *Development of a Computer Controlled System for Continuous Induced Polarization Logging and Spectral IP in Exploration Boreholes*, UNSW 1987).

My role as a field and research project geophysicist in GSNSW continued through to 1988 when I was appointed as Principal Geophysicist, head of the Geophysics Branch, taking on the task of managing the Geophysics team through a period of change from service work

and a variety of research-oriented projects, to a fresh focus on regional geophysics to support geological mapping and mineral and petroleum exploration activity. In support of the first stages of a GSNSW and BMR joint geological mapping project in the Lachlan Fold Belt, we organised the first government-led high resolution regional magnetic and radiometric airborne survey over the Bathurst 1:250,000 Map Sheet, a joint funding and commercial project of the GSNSW, BMR and CGG Geoterrex, (a contractor) which undertook the survey program. The project was a major success and underpinned a new era of integrated geophysical and geological mapping in the mineral-rich Bathurst region.

I fell in love with the process of airborne data acquisition, the flying of the survey and field project coordination and the detailed care and analysis around the positioning of the plane, resolving magnetic and radiometric noise and data issues.

In 1993, I felt it was time to see more of the geophysical world and so I accepted an offer to join CGG-Geoterrex in the Sydney office, largely because of my huge respect for Graham Butt, CEO of the company who I had got to know well in my early years in the GSNSW.

I really enjoyed working with the amazing team of people in CGG Geoterrex Sydney, overseeing all of the data processing and interpretation of survey operations out of our office. That's where I had the great pleasure of meeting and working with your good self, Marina, and Ross Costelloe, Jodie Gillespie, Brenda Franklin, Doug Morrison, Martin Schneider, Mike Hallett, and a whole lot of other people, including Graham Butt, Chris Nind and John Peacock. Dave Dagger, my close research partner from GSNSW also joined us to lead the data imaging work. We all worked hard, learned so much and had a great team spirit working on large projects from around the world.

A change in the ownership and culture of the company in 1997 caused me to leave and to join Encom Technology in Sydney, working with Dave Pratt, Ian Grierson, Peter Gidley, Clive Foss and many others – a positive team environment which I enjoyed until 1999.

In 1999, I was invited to apply for the role of Assistant Director, Regional Geology and Geophysics, of the Geological Survey of NSW and was very pleased to join the leadership team of the GSNSW, working with the well-known Director, John Cramsie (a long-term mentor of mine) and the other highly respected Assistant Directors, Lindsay Gilligan and Peter Lewis. When John Cramsie retired in 2002, I was very lucky to be appointed as the new Director of the Geological Survey and the NSW Government Geologist.

In 2005, following a significant shift in NSW government policy and funding cut-backs and a forced move of the Department to the regional centre of Maitland, I chose to move to Adelaide to take up the role of Director of the Mineral Resources Division in PIRSA.

This was a fabulous era in my career from 2005 through to my retirement in 2017, enjoying the exploration geoscience as part of the Plan for Accelerating Exploration and an active involvement across government and with the Commonwealth and working with and supporting the exploration and mining industry. I really enjoyed my time in South Australia.

MC It's an incredible history and legacy that you've left across many states – a really deep and very strong theme towards public service and doing things for the public good has shone through there. And also working with amazing people, I think that's true.

Question 2. What was one of most incredible things that you either did or that you witnessed? It could be a person, or a discovery, or a changing technology as well. Really one of those things that you witnessed close up.

TT It's a really big question – so many innovations, so many people, so many companies and organisations to praise for outstanding advances in our science.

Starting off as a geophysicist in the GSNSW working in the minerals area and undertaking demonstration electrical surveys on active exploration projects, it was the excitement of a new discovery, a major new discovery in our rocks.

It was probably the most exciting for me and something that really thrilled me and really drove home why exploration geophysics is so important. Ultimately the application of exploration geophysics is not just about the techniques, it's about the discovery and the creation of new knowledge and understanding the earth and identifying new mineral systems and new deposits that will be of enormous benefit and value to the broader community.

My first example is the major discovery of the deep Elura massive sulphide orebody, identified in 1973 as a bullseye anomaly on the edge of a regional airborne magnetic survey undertaken by the BMR over the northern Cobar Basin in NSW. Following early positive drilling results, the exploration company holding this area, Electrolytic Zinc, met with our Geophysics team, advising that they planned to undertake more definitive magnetic surveys, and asked for assistance with ground geophysical surveys.

In the earliest stage of the discovery of the Elura Zn-Pb-Ag deposit, our Geological Survey, the CSIRO (new SIROTEM system) and BMR (trialling MPPO-1 system) worked collaboratively to undertake a wide range of ground and borehole geophysical surveys which helped to define the orebody depth and extent and provided next-stage drilling targets.

Don Emerson, an early Editor of the ASEG Bulletin, and a mentor to many of us, strongly recommended that we compile a case history of the geophysics of this new discovery, which was published as The Proceedings of the Elura Symposium in 1980, Edited by D. W. Emerson (*Bull. Aust. Soc. Explor. Geophys.*, v11, no. 4, 1980). The Elura case history captured some of the earliest successful Australian exploration geophysics applications of ground TEM (Sirotem and MPPO-1), CSAMT, magnetic induced polarization, spectral and conventional induced polarization, borehole electrical & mise-à-la-masse, potential field surveying and petrophysical properties.

The discovery drilling directly on an aeromagnetic bullseye target and the extensive follow-up program of exploration geophysics over this major Zn-Pb-Ag in the 1970s was a really

exciting time. It really drove home the value of geophysics to discovery and really justified for me, in a deep way, why I was doing the job of an exploration geophysicist.

In 1983, production commenced at the major Elura Mine, which was renamed in 2005 as the Endeavour Mine.

MC The excitement and the passion - that's exactly how I feel when you make a discovery. It's all the hard work that goes into it and then it just lights up like, you know, a Christmas tree. So not only obviously leading to a discovery in a major mine, but how other people then use these techniques and technology and information to deploy those in different areas. It has a long lifetime and then the benefits to the economy.

Did you have a second one?

TT When I arrived in South Australia in 2005 (to take up the position of Director Mineral Resources in Primary Industry and Resources SA) the Government's Plan for Accelerating Exploration – PACE – had just started and the first round of the PACE Exploration Drilling Initiative was underway, directly co-funding high priority drilling targets. A small prospecting company held an exploration licence southeast of the Olympic Dam Mine, formerly explored by Mount Isa Mines (MIM), and was granted PACE funding for the first exploration drilling to test a potential IOCG mineral system target identified by coincident magnetic and gravity anomalies. The initial deep PACE holes intersected an extraordinary intersection of Olympic Dam style mineralisation. This PACE “discovery” became known as the Carrapateena orebody, heralding a major IOCG mineral system discovery in a new area of the Gawler Craton.

I had just arrived in SA and was on the ground at the point of discovery with our Chief Paul Heithersay and our Manager of the SA Geological Survey, Mark McGeough. It was super exciting, more so because of the depth under cover of the deposit around 400m.

In the years before this discovery, the Australian Cooperative Research Centre for Landscape Environments and Mineral Exploration had been researching and promoting the importance of understanding the regolith to support successful exploration undercover. This amazing new discovery under deep cover really fostered and encouraged a whole lot of new collaborative exploration research leading to the Uncover initiative and the Deep Exploration Cooperative Research Centre to support the next era of deep exploration.

So, being on the ground at the time of the Elura discovery was super exciting as a young geophysicist. It was amazingly exciting to also be on the ground for the Carrapateena discovery which progressed to the opening of the Mine decline in 2016, during my last year in the South Australian mines department.

MC Carrapateena absolutely pushed boundaries that made people think about what was possible and is still a leading light in successful exploration. People still talk about that discovery.

MC Ted you've talked about your teachers and mentors inspiring you at school and university and when you started out. I found that very powerful because I also had amazing teachers who seamlessly opened doors to knowledge, and you look back and see that was really complicated stuff that they just effortlessly introduced us to.

Question 3. Ted you've covered who inspired you when you started out, but who inspires you today?

TT Over the past three AEGC conferences, co-hosted by our Society, the first in Sydney 2018, the second in Perth 2019 and the third online AEGC 2022, I have been really amazed at the extraordinary professionalism and inventiveness of our early and mid-career geophysicists and also at the advances in numerical modelling, artificial intelligence, data collection systems etc. I think our current generation of exploration geophysicists are doing an amazing job – the presentations on new advances at the AEGC events have really inspired me.

Over my career, there has been a number leaders and mentors and individuals in our science that have really inspired me.

I've talked about Professor Laric Hawkins at UNSW as an early career influence. Also, Dr John Ringis as Principal Geophysicist GSNSW (and leading co-researcher with Laric), had a significant career influence on me over some 15 years.

There are many geophysicists in industry that I've also worked with and been inspired by, for example, during my time at CGG Geoterrex in the mid 1990s, Phil Harman, then BHP Chief Minerals Geophysicist BHP and his exploration team using Geoterrex's GEOTEM system and the BHP Falcon team all inspiring in terms of the group's technology innovations and commitment to research investment.

In my final career years in South Australia, I worked very closely with the GSSA and PACE teams, particularly Dr Steve Hill, GS Director and the Geoscience Australia and other State/NT geoscience leaders and the Cooperative Research Centres.

I learnt much from Dr Neil Williams, former CEO of Geoscience Australia (GA), not a geophysicist, but an outstanding explorer and great exploration geoscience advocate and leader. Likewise, learnings and partnerships with Dr Chris Pigram, also a former CEO GA, and Dr James Johnson current CEO GA. I've also been inspired by the professionalism and inventiveness of the GA geophysics team that you've been part of Marina, including in Dr Peter Milligan, Dr Barry Drummond, I won't mention them all.

My enjoyment and opportunity to innovate in our geoscience has really centred on my career time in the NSW/SA exploration initiatives (Exploration NSW and PACE) and the Geological Surveys of NSW and SA. In the GSSA, I was certainly inspired and learned much from the successive Directors, Mark McGeough, Dr Tim Baker and finally Dr Steve Hill, who is now the eminent Chief Scientist in Geoscience Australia.

A final thought about who has inspired me ... I trained as geophysicist and worked for my first three career decades directly in exploration geophysics, but my career path broadened with a wider commitment to promoting exploration opportunities, developing mining projects and fostering economic prosperity in my final two decades in government.

I would urge early and mid-career exploration geophysicists to not only look within their discipline for inspiring geo-champions but to also look beyond that to a multidisciplinary arena and to multidisciplinary champions, because there's much to learn and much to be inspired by, by looking beyond your immediate discipline.

MC I love that I don't think I can add anything to that ... and yes, they are there - these amazing humans. Also, you are right that the next generation has got some amazing talent and skills. They say on the shoulders of giants, don't they? And I think that there's a lot of hope for our industry.

Question 4. Most of the people that get into geophysics love the travelling part of it. Where are your top 3 career destinations (locations city/country and a little about those places).

TT I've been to every state and territory and region across Australia and just about every major mineral domain in our country. We have an extraordinary country - absolutely amazing. I've had many, many highlights in remote regions, such as BBQing up in the Kimberley with a beautiful sunset! Marina, I know you've enjoyed the same amazing experiences in the Kimberley.

One of my early international destinations, with CGG Geoterrex and then also with Encom Technology was to Botswana in the mid 1990s, working for the Botswana Geological Survey and Government to complete a 300,000 line-km Canadian funded (CEDA) aeromagnetic survey and also a complete set of 1:100000 undercover geology/structural interpretation maps covering the entire northwest corner of the country. Encom worked working with Etheridge Henley Williams (a contractor) to deliver the many interpreted geology map products and Intrepid Geophysics also contributed to designing and implementing a new web data serving solution for the Botswana GS.

This was a really exciting project and an exciting place to work in Africa. Botswana was an amazing and friendly place to visit at that time. The remote survey area covered a large part of the Kalahari Desert and the beautiful Okavango Delta – extraordinary adventures and experiences. I've been back several times. Botswana shares a border with Namibia, also an amazing part of Africa. Camping under the stars in Namid Desert as part of a geo-field adventure was a real highlight.

South Africa was another African adventure that I travelled to with Dr John Bishop, in the early 1990s to present a joint 5-day advanced exploration geophysics workshop to the large Gencor geophysics group, at the initiative of Chief Geophysicist, Barry de Wet. The course covered surface and downhole electrical, electromagnetic and Magnetotelluric methods, practice and innovations. It was a fantastic working over the five days with the highly

professional and energised Gencor team. I learnt so much more than I ever hoped to learn about the culture and the people around an extraordinary period of change as Nelson Mandela became the first black president of South Africa.

The third most extraordinary place that I've visited as part of my geo-travels is the Atacama Desert in Chile. In the mid 1990s, CGG Geoterrex undertook the first fixed wing AEM survey in Chile for the BHP Exploration team – a very challenging survey program at high altitude. In my final career years in South Australia, I travelled again to the Atacama to visit one of BHP's newest open pit copper mines - fantastic landscapes and great mining science and technology in such a harsh high altitude desert environment. This was one of many field visits that I enjoyed with our mining Minister and other political leaders to appreciate at close quarters, the importance of early-stage exploration leading to new mineral discoveries and new mining developments which deliver prosperity and jobs for regional communities and nations.

This was one of many remote field visits that I enjoyed with our then Minister, Tom Koutsantonis, which again highlighted the importance of early-stage exploration leading to new mineral discoveries, economic prosperity and thriving remote regional communities.

MC Geophysics does offer the opportunity to see some remarkable places and stay in places where you do feel a part of the community, you really do get to feel like you belong to somewhere rather than just passing through like a tourist. So, I love your top three plus the Kimberleys - one of my favourite places as well.

MC We have got a lot of people in our industry who end up being a science/deep domain expert and because they're so successful they end up becoming managers of people, managers of projects and in the end they become leaders.

Question 5. Do you have a piece of advice you could give to up-and-coming leaders?

Such an important question - probably the most important question you've got to ask me.

I think I can probably sum it up in a few words, what my key advice is, however, I need a little bit of a preamble first to explain why.

We all appreciate that management of the team is not the same as leading the team.

Many Australian geophysicists who have become deep experts in their specialist discipline take on a role of leading a research team in an institute, CSIRO, a university or in Geoscience Australia and state geological surveys.

The key element for that management/leadership is about championing or being the champion of the science and the champion of the geo- innovation. That's a subset of a broader skill necessary for leadership of a wider multidisciplinary team of people and in that role, building confidence in team-building skills.

The most important principle here is empowering your people to be the best possible scientist and collaborator and partner in the team that they can possibly be.

As a leader you have the challenge of coaching them and encouraging them to move into that space rather than sitting in the corner just working on the science.

So, the coaching, mentoring role of the leader is so fundamental to successful leadership.

One of my mentors/influential leaders was Barry Goldstein who was the Executive Director of the Energy Resources Division – Petroleum and Geothermal sectors. I joined the SA mines department in 2005. Barry was a geophysicist, so we had some common ground and great discussions from the earliest collaboration.

On my first meeting in this new role, I asked Barry, “What do you do around here?”

Barry’s immediate response was “We build trust and reduce uncertainty” – that underpinned our collaboration, working closely with Barry over my 12 years in government.

That is such a key bit of advice for any leader and for the team you lead or in engaging with constituents, partners and collaborators.

A key part of leadership is not just about the mentoring/coaching, it's also about advocating for the funding/resources for the team that will underwrite the success of and the deliverables from the team. All of that is a blend of the spectrum of management through to leadership. The most high-performing teams have leaders and deputy leaders and group leaders and team leaders that are focused on listening to their teams, working with them and every day working on that value of building trust with their teams.

In government and public geoscience leadership, it’s also about building trust with the community and across government with other agencies like the conservation agency, land management groups to ensure that access to land for exploration is maintained.

Barry’s leadership motto is good advice to all - building trust and reducing uncertainties so that your team and your partners know where they're going and have confidence, trust and respect in you and also in their colleagues.

MC This sums it up in a nutshell. Excellent advice “build trust, and reduce uncertainty”. That gets rid of so many barriers and problems, and builds confidence - perfect advice for anybody who's up and coming as a leader. But for everybody who leads themselves or leads a small team, really, really important.

Question 6. What is one piece of advice you could give an up and coming geophysicist on the science side of things?

TT As an early career geophysicist, I read widely and also read widely outside of my specialist discipline of electrical and electromagnetic geophysics.

My PhD was in a narrow area borehole electrical and induced polarization logging and downhole spectral IP measurements – electrical petrophysical properties in-situ. However, I'd read widely and understood how important those parameters are to understanding the concept of a mineral system and to understanding the parameters you need to design a successful electrical geophysical survey. So, my advice to early career geoscientists is to read widely and look outside your discipline for out-of-the box ideas and inspiration.

I would also encourage early career geoscientists to take on projects that are really challenging. One of the things I've said to a lot of young scientists is to be prepared to bite off more than you can chew and then really chew like crazy and follow it through to the end point or final result. Really build your skill sets around project management and progressive delivery or accomplishments.

So, to bite off more than you can chew and project manage to successful outcomes.

MC That's exactly what I thought you were going to say. About 30 years ago, you gave me that advice, and I remember it was one of those turning points. You said, Marina, why don't you go and do XYZ? And I remember saying to you, I'm not clever enough to do that. And you said, of course you are. And we're here to help you. And it was a real pivotal moment. Like, somebody believes in me and, you know, I can ask for help to take that on. It was probably the beginning of my career, really that day. I really thought you'd say something along those lines. It's true.

We're coming nearly to the end of our interview today and while we're winding up, I think I've got one more question for you. I just wanted to thank the Australian Society of Exploration Geophysicists for facilitating this interview today. And just to let people know, there is a document on the ASEG History pages where you can read Ted's bio. I also wanted to thank Roger Henderson for being the History champion for the ASEG for so many years as well.

MC So, just wrapping up Ted, you've had an amazing career, a huge impact on so many people and such an impact on the economy as well. And we can't capture all of that in a half hour of conversation.

Question 7. What would you like people to remember about your career? What are some of your highlights?

TT Thanks Marina for reminding me of our time in CGG Geoterrex. The time we all had together, learning together and working together, it was a wonderful and rewarding team experience and for me, a really happy time as a scientist and a member of the Airborne Data Processing & Interpretation team that really delivered so much.

I would hope that our Society and also the broader exploration sector is aware of my long term advocacy for exploration potential across Australia at international conventions and my contribution to building public geoscience and public exploration geophysics initiatives and programs in NSW, SA, contributing to the National geoscience mapping coverages and public geophysical and other geoscience datasets. I've always been a collaborator and a partner wanting to work within a team to deliver great new regional exploration geoscience data and products. I'm proud of the working and major project partnerships that I forged with the other Australian state/NT geosurveys, BMR/AGSO/Geoscience Australia/CSIRO, other research institutes/universities, with the exploration, particularly through the Australian Minerals Industries Research Association and with international geoscience agencies in Ontario, British Columbia, Saskatchewan, US Geological Survey and China Geological Survey

I'm particularly grateful to the NSWGS for trusting me to take forward the first major high resolution (250m survey lines) airborne magnetic and radiometric survey in Australia in 1989 over the Bathurst 1:250000 Map Sheet in partnership with BMR and CGG Geoterrex. This was ground breaking initiative for a state and federal and airborne survey contractor to deliver – a great pilot study into the high value of public geoscience in bring forth strong exploration activity – which convinced State Treasury to fully co-fund future public geoscience surveys with the Commonwealth.

The State/NT geological surveys have worked in positive partnership over the past two decades with BMR/AGSO/Geoscience Australia through the constructive working arrangements under the National Geoscience Accord and the Australian Chief Government Geologists group which was rejuvenated in the mid 1990s under the new leadership of Dr Neil Williams. I very much enjoyed working with Neil and his AGSO/GA teams – we achieved much together.

A final area of career achievement – over my 12 years in South Australia as a lead regulator of the exploration sector and the mining, quarrying and opal sectors, our minerals geoscience and regulatory teams worked very hard to put in place modern policies, a new legislative framework and genuine community and traditional owner engagement. All of this designed to support sustainable growth and operations of the minerals industry but within leading practice regulation, fostering those principles of building trust and reducing uncertainty and setting clear rights for landholders and communities and clear rights and responsibilities for explorers and mining developers with an expectation of respectful community engagement leading to a trusted social licence.

MC I want to thank you so much for your time today and for sharing so much of your career and your life with everybody who's going to listen. And with me today, really a pleasure.

Question 8. What has the ASEG meant to you?

The ASEG has been at the very centre of my science from my undergraduate years – Laric Hawkins, a foundation signatory of the Society in 1970, pressed all of his undergraduate to

join the Society upon graduation. The ASEG has been a cornerstone and key point of reference for learning throughout my science career. I'm very proud of the ASEG's publication works over 50 years and our Society has an enviable record of delivering the best exploration geoscience conferences for more than 40 years. I was proud to be part of the organising team for first of our ASEG Conferences in 1979. We have a fantastic science society with much to be proud of. I hope all of our young geoscientists in the ASEG really look to value the Society's heritage and contribution to our evolving science of exploration geophysics.

MC Thank you Ted !