Oct 2021

GSH Journal

The Epicenter of Geophysical Excellence

GEOPHYSICAL SOCIETY OF HOUSTON
Volume 12 • Number 2

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On The Cover...

Seismic data acquisition in Kurdistan.

Picture courtesy of Wireless Seismic.

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Dec 2021 .... **Oct 15, 2021**
Jan 2022 .... **Nov 16, 2021**
Feb 2022 .... **Dec 16, 2021**

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A Word from the Board

By Marianne Rauch, First Vice President

It's been more than half a year since my last Word from the Board article and some things have changed but others not so much. The oil price is much higher, but activities are still relatively low. COVID numbers dropped substantially until the Delta variant started to spread and safety measurements that have been relaxed were often re-instated. And, I hear repeatedly that there is no future for geophysics. I wrote an article describing my thoughts on this subject for the IMAGE21 convention and I like to share with you some of my musings.

Traditionally, geophysics has been playing a major and crucial role in oil and gas and mining exploration. Seismic and potential fields data are main contributors to the discovery of hydrocarbon fields and mining deposits. With the Energy Transition taking place we see new and exciting opportunities for geophysical methods. Numerous studies commissioned by governments and the private sector indicate that hydrocarbons will remain a needed commodity for some time to come but the industry needs also to focus on decarbonization efforts. We must invest in new energy innovation efforts and diversify.

Renewable energy sources are researched and have already been successfully executed as the product costs have been significantly reduced over the last decades and the technology has improved. Wind and solar leave very little environmental impact and are favored. Besides finding a location with high and if possible continuous airflow, it is also important to carefully map the near subsurface before installing windmills and solar panels. High resolution seismic and potential field data are suitable for this task.

Geothermal energy requires high temperatures at the reservoir interval and rocks that allow water to flow through, high porosity and permeability. The caprock needs to seal and prevent water from escaping. Seismic data and derivates like rock property and porosity attributes are essential. Magnetic data can assist in predicting temperature measurements.

CO2 is a by-product of many energy generating processes and needs to be removed from the atmosphere and stored below surface in a sealed reservoir unit. Seismic data can map and monitor those units and attributes derived from the pre-stack data can be converted to rock properties which are very useful in mapping reservoir seals.

Fresh water is an essential ingredient of life and with the increase of the world population, we also need to increase water sources. Resistivity and gravity can be applied to map aquifers and to monitor them. Other applications include planetary geophysics, asteroid mining, assisting in criminal investigations, deep sea mining and additional uses that will evolve.

In summary, the application of geophysics in its current form will be relevant for many decades to come but is already expanding from hydrocarbon exploration and exploitation and mining to other disciplines related to renewable energy, planetary exploration, environmental applications and more. I see the future of geophysics as being bright and interesting as long as we can evolve and utilize our knowledge in different ways when the demand in certain sectors changes.

As a final comment, I like to mention that the GSH is moving to hybrid technical events and I look forward to seeing you again in person at various technical and social events. One of the goals of the GSH is to bring members together and these are perfect opportunities to catch up with old colleagues and friends. □

Unconventional SIG

Fiberoptic Wide-band Acoustic Multi-component Sensors

Jakob B. U. Haldorsen, MagiQ Technologies

Abstract and Bio

Online Event - Oct. 7, 2021 - 12:00pm-1:00pm CST

Register

Tech Breakfast

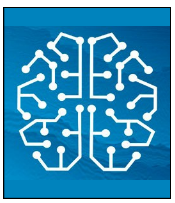
Towards High-Fidelity Imaging: Dynamic Matching FWI and its Application

Dr. Jian Mao, TGS

Abstract and Bio

Online Event - Oct. 13, 2021 - 7:00am-8:00am CST

Register



Data Science and Machine Learning SIG

Geo2Data Workshop 1:
Visualizing Data in Python – Oil and Gas Applications

John O'Donnell, Altay Sansal, and Eduardo Alvarez

Abstract and Bio

Online Event - Oct. 13, 2021 - 11:00am-5:00pm CST

Register

Technical Lunch

Drilling for Geothermal; Opportunities for Technology Cross Pollination

Danny Rehg, Criterion Energy Partners (CEP)

Abstract and Bio

Hybrid Event - Oct. 20, 2021 - 11:00am-1:00pm CST

Register

Data Science and Machine Learning SIG

The Future of Open Source Earth Science Data in the Cloud: @Earth

Kyle Jones, Amazon Web Services (AWS)

Abstract and Bio

Online Event - Oct. 27, 2021 - 11:00am-12:00pm CST

Register

Unconventional SIG

Evaluating 3D and 4D DAS VSP Image Quality of Subsea Carbon Storage

Mark Willis, Halliburton

Abstract and Bio

Nov. 4, 2021 - 12:00am-1:00pm CST

Register

Guided Boats,
Cash Pots,
Trophies

20th Annual Saltwater Fishing Tournament

October 8, 2021
Harborwalk,
Hitchcock, Texas

NEW EVENT

1st Annual GSH FALL Golf Tournament

November 8th, 2021

Hearthstone Country Club

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2021 GSH FALL FORUM

Carbon Capture, Utilization & Storage (CCUS)

The Path to a Zero Carbon Future

November 18, 2021

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2. Reservoir and Caprock Characterization
3. Injection Operations and Induced Seismicity
4. Containment Monitoring and Leakage Risk Mitigation
5. CO2 EOR and Economics
6. Regulatory Environment and ESG

For Sponsorship and Registration info, call the GSH @ 281-741-1624 or visit gshtx.org

Memorial Tribute

MICHAEL W. BENNETT 1938-2021

We are saddened to report the death of Michael Bennett from prostate cancer.

Michael was educated in the UK where he received a Bachelor"s degree from Southampton University (1959) and a Master's from Imperial College (1962). He first worked for BP in Libya and then did a short stint in Greenland. He joined Chevron in Houston (1966) at the beginning of the seismic digital revolution. His career was almost entirely in seismic data processing. Michael worked for Chevron (except for a few years seconded to Amoseas) for most of his career, finally retiring as a consultant in 2006.

Michael was known and liked throughout the geophysical profession and he will be missed.

DAVID JENKINSON

https://www.tributearchive.com/obituaries/22007399/michael-william-bennett

Examples of Seismic Resonance from Air-filled Voids

Steven D. Sloan and Daniel Z. Feigenbaum, U.S. Army Engineer Research & Development Center*

Summary

Examples of resonance associated with shallow air-filled voids are shown from experimental seismic surveys. Basic data processing was applied based on previously reported studies to determine if resonance is observed over known void locations. Expanding the study to voids of different sizes, at varying depths, and in a range of different geologic settings would help to better understand its potential as a tool for detecting and localizing near-surface voids.

Introduction

The search for subsurface voids by both direct and indirect means using seismic methods has been ongoing for more than half a century. Cook (1965) first employed seismic reflection methods to identify and delineate brine-filled cavities associated with solution mining. Watkins et al. (1967) sought to identify a method capable of detecting near-surface voids during lunar exploration on the moon that could be used for shelter during meteorite showers or as cold traps for ice accumulation. They observed persistent oscillations lasting for as long as four seconds recorded over lava tubes in California, USA. Rechtien and Stewart (1975) attempted to duplicate the work by Watkins et al. over a karst void in Missouri, but were unsuccessful in recording anything that appeared to be resonance.

Korneev (2009) showed persistent oscillations in experimental data collected over a water-filled barrel buried 5 m deep, ultimately determining that circumferential waves propagating around the boundary between the barrel and the surrounding medium were responsible for the ringing. He presented a data processing flow that called for applying a narrow automatic gain control (AGC) window to boost the relatively low amplitudes of any ringing wavelets present, identifying peaks in the frequency-amplitude spectrum, and applying a frequency filter with a narrow passband around the peak frequency to enhance the ringing wavelets at the expense of everything else. What remains is a hyperbolic monochromatic signature of a secondary source with the apex indicating the lateral location of the anomaly along the seismic line.

Rubin et al. (2014) demonstrated a ringing effect over several different small shallow targets, including a rectangular cavity, cylindrical cavity, metal box, and a powder-filled plastic barrel at depths ranging from 0.2 to 2 meters. Through modeling they determined that ringing occurred when the P-wave velocity (VP) of the target is less than the S-wave velocity (VS) of the embedding medium due to impedance contrasts.

Figure 1. Photo showing the void from Example 1.

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Schneider et al. (2017) also showed the presence of acoustic resonances in gas- and fluid-filled spherical cavities using modeled seismic data as a potential method of detecting evidence of subsurface nuclear explosions. They concluded that in the case of a gas-filled cavity where there is a large contrast in impedance between the elastic and acoustic media, that internal oscillations are nearly undamped with resonance occurring in narrow frequency bands. Low energy transmission translates to limited damping; however, if approaching critical damping, oscillations become overdamped and the resonance will disappear.

Methods

This paper presents field-based examples of resonance observed in common source and receiver gathers from air-filled voids at depths greater than previously reported in other studies. Minimal processing has been applied and is based on the method described by Korneev (2009), including application of an AGC window and a bandpass frequency filter. Examples presented here were collected independently as parts of separate studies, hence the acquisition parameters and equipment may change from one to the other.

Examples

The void in the first example *(Figure 1)* measures approximately 1.25 m wide by 1.25 m tall. The

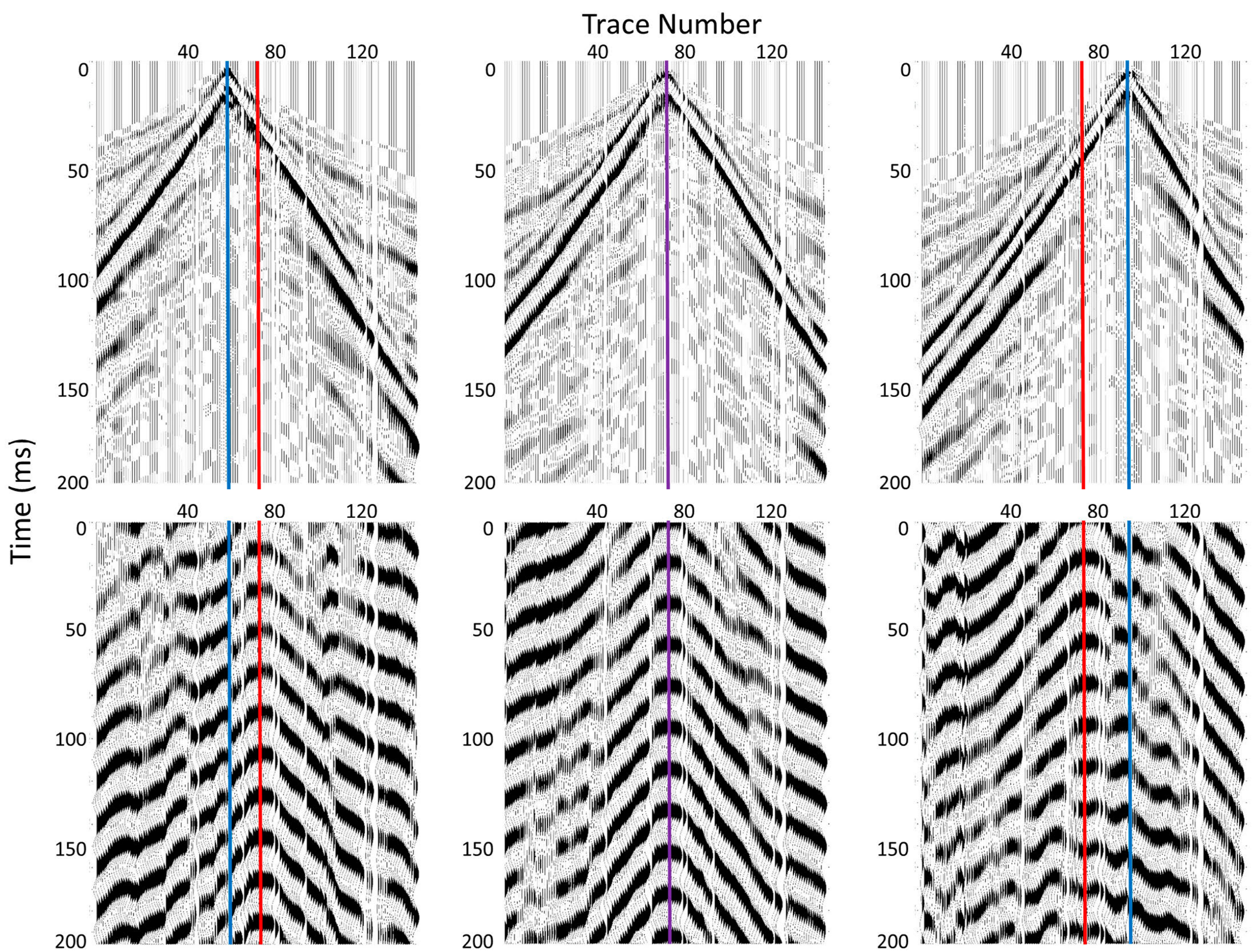

Figure 2. Shot gathers before (top) and after (bottom) processing. Blue lines indicate the source locations, red lines the void location, and purple where they are coincident.

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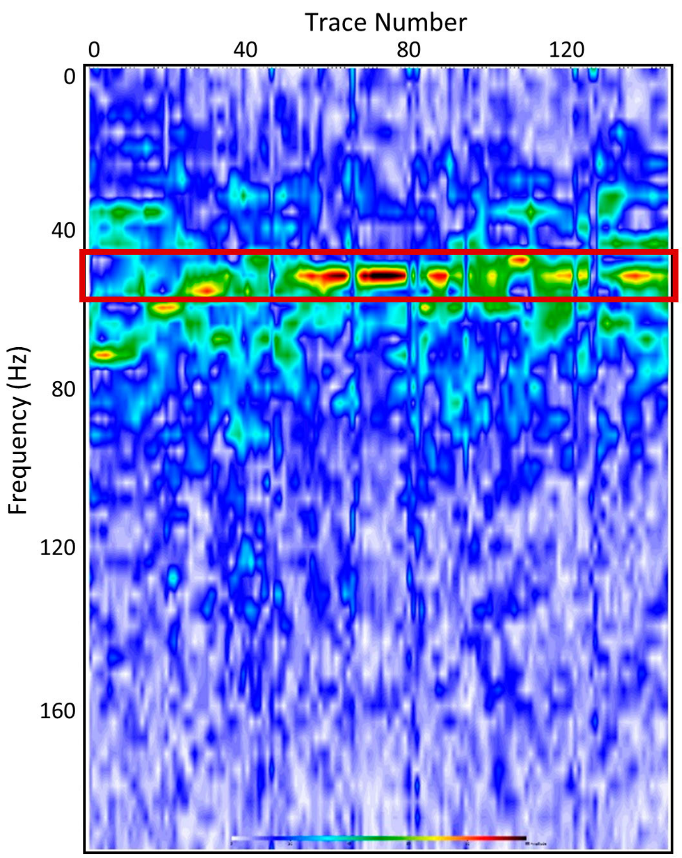

Figure 3. Trace-by-trace frequency-amplitude plot highlighting the resonance at ~52 Hz.

Figure 4. Picture showing the void described in the second example.

depth to the roof is ~3 m. It was constructed using a 6 m by 6 m vertical shaft for entry, exit, and spoils removal. The horizontal shaft was excavated without disturbing the overlying geology. The shaft is shored with wooden beams and lined with wooden boards (Sloan et al., 2013).

The site is located in the northeastern portion of the Great Basin near the Great Salt Lake, a sub-province of the Basin and Range province in the United States. The area of investigation is underlain by a thin layer of Holocene-age eolian sheet-sand deposits overlying Pleistocene-age lacustrine deposits related to the former existence of Lake Bonneville. Drilling at the site yielded 0.5–1.0 m of eolian sheet sands across the entire site, underlain by fine-grained lacustrine deposits. The eolian deposits consist of fine-grained, loose to medium-dense silty sand and sandy silt. The lacustrine deposits are comprised of alternating layers of silt, sandy silt, and silty sand, overlying gravelly sands and clayey sand toward the bottom of the borings.

Seismic data were collected using 144 40-Hz vertical geophones with a 0.25-m spacing. The source was a 7.3-kg (16-lb) sledgehammer striking a steel plate every 0.5 m. Three impacts were recorded at each source location and saved individually for subsequent quality control and processing. Data were recorded using six 24-channel Geometrics Geode seismographs with 24-bit A/D conversion. The sampling interval was 0.25 ms with trace lengths of 256 ms.

Figure 2 shows three shot gathers with no processing applied (top) and after applying a 5-ms AGC window and bandpass frequency filter of 48-56 Hz (bottom). The blue lines mark the source position, the red lines indicate the void location, and the purple line is their coincident location. Notice that in the first and third gathers that even though the source location is to the right or left of the void, the apex of the resonant energy still lines up with the position of the void. *Figure 3* shows a trace-by-trace frequency-amplitude plot of the middle shot gather from *Figure 2*, displayed as a percentage of total amplitude. Note the high-amplitude band at approximately 52 Hz.

A second example is presented from a former U.S. military base camp in Iraq (Tucker et al., 2007). The void measures 1.2 m tall by 1.2 m wide, also shored and lined with wooden beams and boards *(Figure 4)*. The depth to the roof of the void is approximately 6 m. It was also constructed by first excavating a vertical shaft and then digging a horizontal shaft to avoid

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disturbing the overlying sediments. The site is comprised of various layers of fine-grained sediments, including eolian silts and sands, compacted silt and clay layers, and unconsolidated sands.

Data were collected using a fixed spread of 72 40-Hz vertical-component geophones spaced every two feet (0.61 m). The source was a sledgehammer impacting a steel plate every two feet (0.61 m). Four impacts were stacked in the field and recorded at each source location. A 25-ms AGC window was applied, followed by a 47-50 Hz bandpass frequency filter. *Figure 5* shows a gather after a 25-ms AGC window has been applied (left), followed by a 47-50 Hz bandpass frequency filter (right). *Figure 6* shows a trace-by-trace frequency-amplitude plot of the same gather, displayed as a percentage of total amplitude. Note the high-amplitude band at approximately 48.5 Hz.

Discussion

When considering the three different studies by Korneev (2009), Rubin et al. (2014), and Schneider et al. (2017), there is not a consensus as to the mechanism that is causing the resonance or how it is propagated. Korneev (2009) proposed that the resonant phenomenon is a product of circumferential waves propagating as Rayleigh waves around the free surface boundary between the acoustic medium and the surrounding elastic medium, which release low-amplitude shear body waves over time. Rubin et al. (2014) compared the spectral response of a microphone inside of an excavated cavity and a geophone at the surface with similar results and they determined that the resonance recorded at the surface is dominated by the acoustic modes generated from inside the void. Schneider et al. (2017) presented a

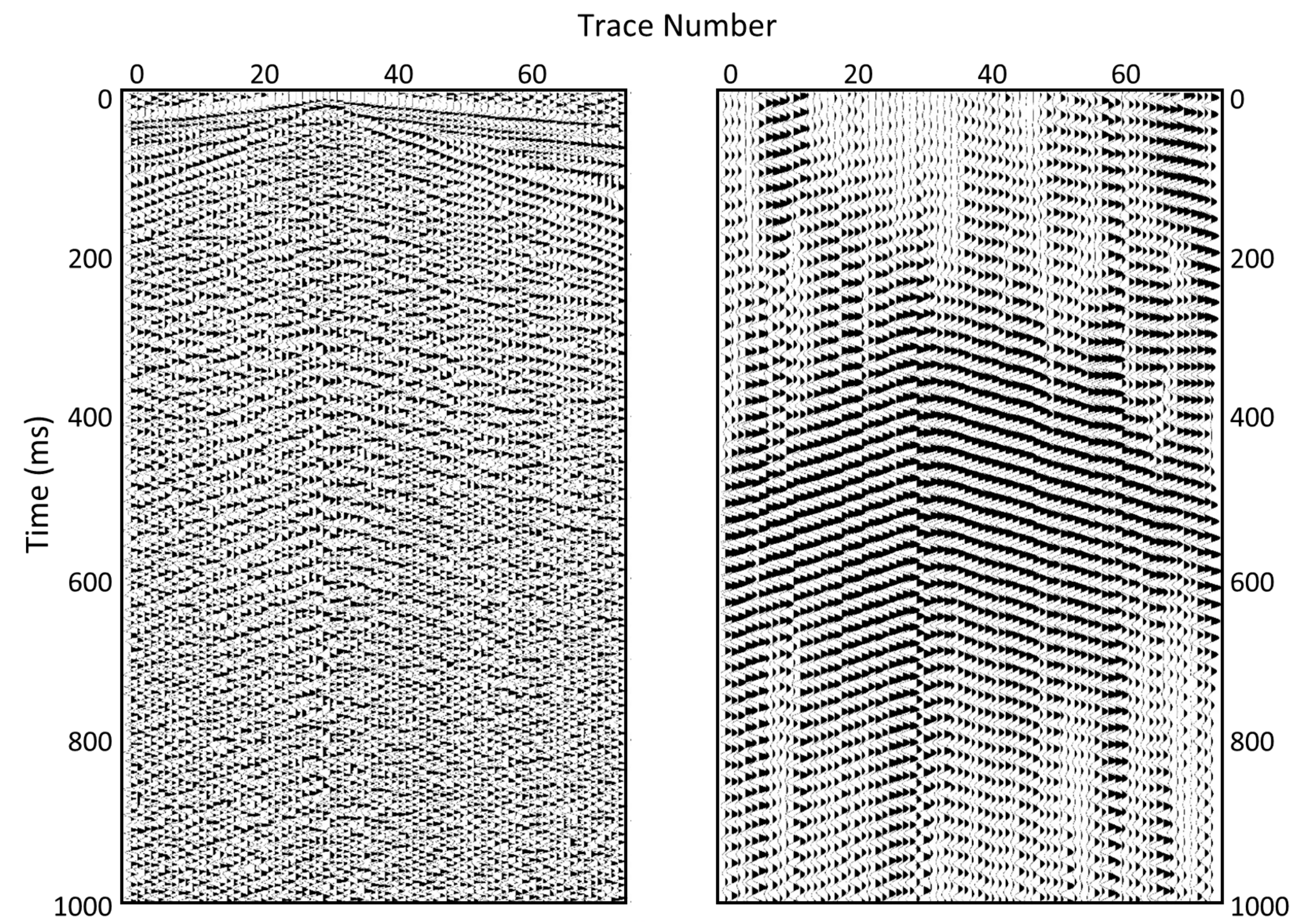

Figure 5. Data gather displayed after a 25-ms AGC window (left) and a 47-50 Hz bandpass frequency filter (right).

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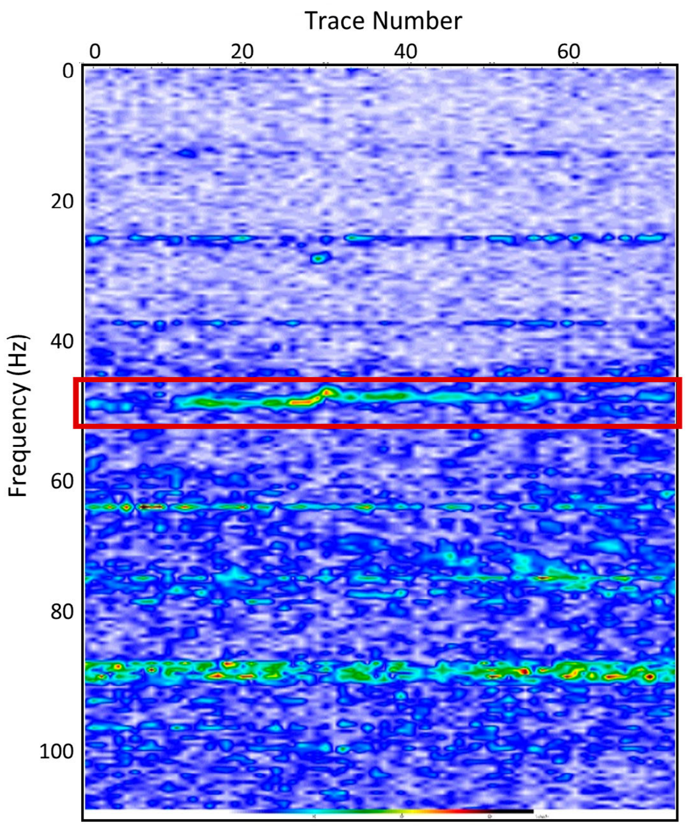

Figure 6. Trace-by-trace frequency-amplitude plot highlighting the resonance at ~48.5 Hz.

study based on synthetic modeling that suggests internal reflection to be the culprit. In that same vein, it should also be pointed out that there are differences across the studies as well. The Schneider study included a much larger void (60 m in diameter) approximately 250 m deep that represents a void left after a large-scale explosion. Compared to the work presented here, the depths are greater than the targets interrogated by Rubin et al. (2014) and compared to Korneev's (2009) experiment, the target dimensions are larger (0.6 m vs. 1.25 m) and the target velocity is much higher in the water-filled barrel. In this case, our experimental parameters are more closely aligned to Rubin et al. and likely translate to similar propagation mechanisms.

Rubin et al. (2014) tested a variety of dependencies, including length and depth. They determined that the resonant frequencies generally decrease as depth increases and that depth does not affect the frequency, but does impact the amplitude of the response. In the examples presented here, the longer void (20 m vs. 6 m) exhibited a slightly higher resonance frequency (52 Hz vs. 48.5 Hz); however, with only two examples it is difficult to support a relationship one way or the other. More examples from targets of different sizes, at different depths, and in a range of geologic environments are needed to determine how consistent the phenomenon is across variables.

Despite the path taken by modeling and/or experimentation, one thing they all have in common is that resonance is observed in the vicinity of air-filled voids; however, the mechanism that generates it and the propagation and interaction of different modes is a complex problem.

Commonalities between the two examples shown here:

- the resonance is not readily discernible on common source or receiver gathers or in spectral plots without processing applied to boost the amplitudes of the ringing wavelets;
- source locations from relatively longer offsets did not produce the ringing effect and required the source to be close to the target;
- both of these examples used vertical-component geophones. Horizontal geophones were not used in either case, which presents another avenue of investigation recording multiple components of the wavefield.

Conclusions

Two examples are presented here where seismic resonance is observed from subsurface air-filled voids. In these instances the resonance was not apparent on raw shot or receiver gathers without additional processing applied to increase the signature amplitudes. The source did have to be in close proximity of the surface location of the void to generate the persistent oscillations. Both of these examples focused on the vertical component, but horizontal components may also provide additional information.

More work is needed with additional examples from different depths, variable size voids, and in different geologic settings (or a range of seismic velocities) to determine the feasibility of using this method as a direct detection method. Additional data processing strategies may also be employed to more effectively highlight the signal of interest at the expense of other energy.

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Acknowledgments

The authors wish to thank Owen Metheny and Jordan Nolan for their efforts in the field collecting data used in example number one and Dr. Jason McKenna for sharing the seismic data for example number two.

Permission to publish was granted by Director, Geotechnical & Structures Laboratory. □

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Permalink: DOI: https://doi.org/10.1190/segam2020-3426765.1

GSH Movie Time

Now Showing

Processing Overview - Part II*

Lecture by John Wardell - 1982

The May 2021 issue of **GSH Movie Time** presented the lecture "Processing Overview: Part I". This month, **GSH Movie Time** presents the second of the two lectures. The overview goes over the seismic processing of reflection data; that is, processing of the seismic data to produce seismic sections which represent a cross section of the geologic structures in the earth below the seismic line.

In the first of these lectures, we looked at the geometric processes which are used to correct for the geometry of the recording system. In this lecture, we look at the signal enhancement processes which are used to remove some of the unwanted noise, including multiple reflections of the seismic wavefield.

Click on red ticket to view movie

*** GSI vintage videos courtesy of Schlumberger – WesternGeco**

Mystery Item

This is a geophysical item...

Do you know what it is?

This month's answer on page 16.

Item Of Interest

Only two people ever served as President of both the AAPG and the SEG. Donald Barton was elected the first and second President of the SEG and was President of the AAPG for the 1938--1939 term. He served out his term only a few days before his death. Paul Weaver, the third SEG President, was the other person to be elected President of the AAPG. Both Barton and Weaver were granted Honorary Membership in the SEG. □

AAPG

SEG SOCIETY OF EXPLORATION GEOPHYSICISTS

The Mystery Item
on page 15
is a
an optical analog gravity computer from the 1960's

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The Geophysical Society of Houston is a 501(c)3.

Fall Warm-Up Sporting Clays

60+ shooters braved the heat to take part in the Fall Warm-Up Shoot on August 26th. The GSH would like to thank everyone who participated and everyone who helped put the event together. As always, huge thanks to all our generous sponsors: Weir Consulting, Ensign Natural Resources, Petrophysical Solutions Inc. (PSI), Nodal Seismic, Z-Terra, Down Under Technology (DUG), and American Shooting Centers (ASC), who all combined to make this event possible. All proceeds raised will go to worthy GSH causes, including scholarships funds, student memberships and educational outreach.

In addition to the sponsors mentioned above, the GSH would like to thank Allan Grimes and Archive Data Solutions for providing the delicious food that everyone enjoyed after the shoot. Thanks also to DUG and Z-Terra for providing beverages to wash down the delicious pulled pork Allan whipped up!

Trophy winners were: Steve Mitchell – Lewis Class AA, Will Stewart - Lewis Class A, and Ivan Cisneros – Lewis Class B. Ladies HOA was won by Kasey Phelps.

Once again, thanks to all who made the event possible, we hope to see you next year at the Spring Shoot!

- Scott Sutherland, Chair

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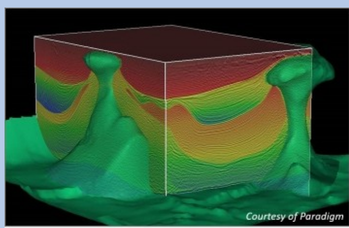
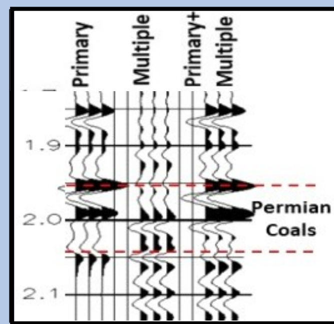
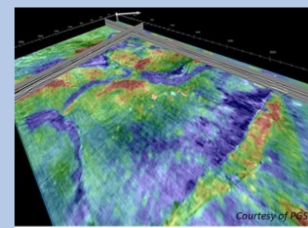
The GSH - SEG Webinar Series is Online

Access the recordings of these webinars originally presented live from the convenience of your home or office and according to your own schedule.







Title	Presenter
– Seismic Modeling, Migration, and Inversion	Bee Bednar
– Beyond AVO to Quantitative Inversion Interpretation QII	Bill Goodway
– Affordable S-Wave Reflection Seismology	Bob Hardage
– Simplifying and Lowering the Cost of S-Wave Reflection Seismology	Bob Hardage
– Carbonate Essentials	Chris Liner
– Basic Seismic Interpretation	Don Herron & Bob Wegner
– Basics and UPDATES on Anisotropy: Azimuthal P-P for better Imaging, Fractures & Stress Analysis Acquisition, Processing & Interpretation	Dr. Heloise Lynn
– Geophysical Signal Processing 101	Enders A. Robinson & Sven Treitel
– Seismic Amplitude 20/20: An Update and Forecast	Fred Hilterman & Mike Graul
– Extracting Geology from Seismic Data	Fred Schroeder
– Applied Azimuthal Anisotropy-Azimuthal 3D P-P Seismic: WHY Bother?	Dr. Heloise Lynn
– Understanding Seismic Anisotropy in Exploration and Exploitation	Leon Thomsen
– An Introduction to Borehole Acoustics	Matthew Blyth
– Topics in Land Seismic Data Acquisition, Processing, & Inversion	Oz Yilmaz
– Everything You Always Wanted to Know About Microseismic Monitoring	Peter Duncan
– Full-Wave Seismic Exploration: Acquisition, Analysis, & Applications	Rob Stewart
– Introduction to Applied Depth Imaging	Ruben D. Martinez
– The Interpreter's Guide to Depth Imaging	Scott MacKay
– Machine Learning Essentials for Seismic Interpretation	Tom Smith
– Modern Seismic Reservoir Characterization	Leon Thomsen
– Borehole geophysics: Using rock properties, well logs, & all kinds of seismic methods	Rob Stewart

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SOCIETY OF EXPLORATION GEOPHYSICISTS

U of H Wavelets

NextGen - UofH Wavelets

Back to School Happy Hour – Truck Yard Houston

by Peter Lanzarone, NextGen Committee Chair

With in-person events beginning to start again for the GSH and other organizations, NextGen joined forces with the University of Houston Wavelets for a back-to-school event on August 26, 2021. We had 14 attendees from UofH and Rice, as well as GSH members working in the industry that spoke with students. NextGen handed out our new promotional koozies as a thank you to all the attendees with the GSH logo and "I Heart Seismic" insignia. We think our guests enjoyed these memorable gifts and will hopefully use these to spark geophysical conversations with their colleagues and friends.

Based on the success of this event, we hope to put on more in-person events where students and industry professionals can network in a relaxed, laid-back atmosphere. Keep a lookout for future events like this and contact any NextGen member if you are interested in serving as a mentor for early career professionals or students. □.

Doodlebugger Diary

Beginning the First Field Trip, Antarctica 1970

By Les Denham

The Doodlebugger Diary recounts the experiences of geophysicists during their working lives. This month we have the first of a number of occasional contributions by Les Denham, author of the 2020 book 'Blizzards and Broken Grousers', published by SEG. This book is the recounting of Les' experiences during the Antarctic field operations in 1970-71. His crew's objective was to document ice thickness using radar, gravity and magnetometer data. Les now devotes a lot of his time helping Bill Gafford document the huge amount of material at the GSH Geoscience Center, including getting that data incorporated into the SEG Wiki.

If our readers have stories of their early careers they would like to share, please send them my way. I'll be happy to print them in this segment.

I had planned our first field trip in the 1970 glaciology program to start "two to three weeks after arrival in Antarctica". We (the 1970 wintering party) officially took control of Casey Station *(Figures 1, 2 and 3)* on February 16. So we expected to be able to leave for the field around March 2.

We didn't.

Figure 1: Casey Station, viewed from the air in 2005 (By Graham Denyer - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=73001020).

Doodlebugger continued on page 26.

If you would like to add stories to the Doodlebugger Diary, send them to: Scott Singleton at scott.singleton@comcast.net
or mail them to Box 441449, Houston, TX 77244-1449

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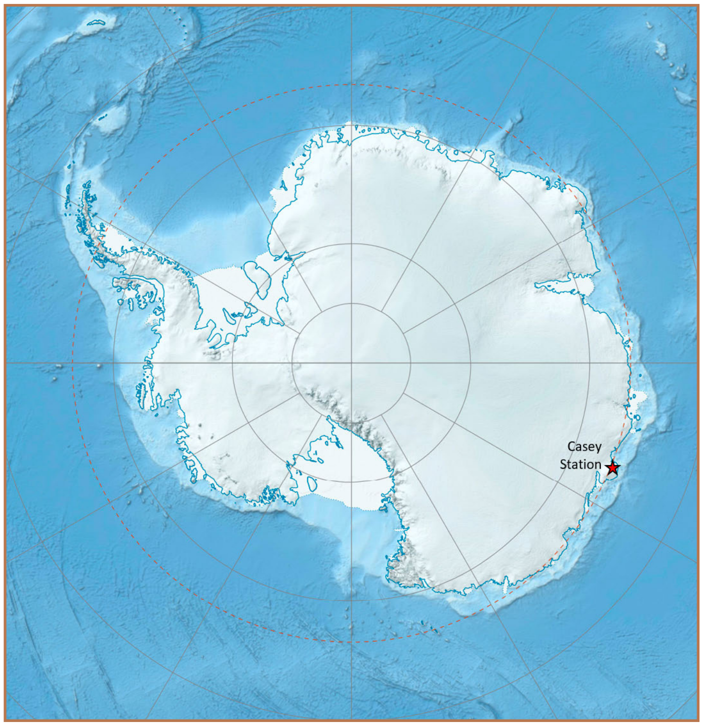

Figure 2: Location of Casey Station in Antartica (By Alexrk2 - Own workData from http://nsidc.org/data/moa/ *- Haran, T., J. Bohlander, T. Scambos, and M. Fahnestock compilers. 2005. CC BY-SA 3.0,* https://commons.wikimedia.org/w/index.php?curid=9536525*)*

I expected to have a few tasks before our equipment would be ready for the field. On March 3, when we should have been on our way, or at least ready to leave, I made a list of mechanical repairs we had found we needed before starting our year's work:

1. The new Nodwell 110 tracked carrier *(Figure 4)*, the key vehicle for the field operations, needed to have a leaking fuel tank repaired, ice grousers fitted, and a rack built for carrying marker canes. The 'diesos' (diesel mechanics) did all of this kind of work. (Note: 'ice grousers' are devices intended to increase traction of continuous tracks, especially in loose materials such as soil or snow. Ice grousers are commonly spiked cleats inserted in each track segment).

2. The new Caterpillar D4 tractor (a common small Caterpillar track-type tractor), the prime mover for our field logistics, needed all its grouser plate bolts replacing because the thread on them had been stripped by overtightening; it needed a cabin heater to be fitted; its electrical system needed to be changed from 12 volts to 24 volts; and it needed fitting with ice grousers. Each of the track grousers was attached to the track chain by four bolts, and we had to replace all of them. I personally replaced perhaps a hundred of these bolts, unscrewing them with a hand wrench, running the new nut onto the new bolt by hand, and finally tightening it with a torsion wrench.

3. The older Nodwell (see *Figure 1* in September Doodlebugger Diary for image), also essential for field operations, needed a complete engine overhaul, including replacing a cracked head; the starter needed repairing; so did the generator; and the differential needed overhauling. I did not know enough to be much help with this, but I watched part of the engine overhaul, and so learned a lot about Detroit Diesel engines.

4. Our field living quarters, two RMIT caravans, both needed the sledges under them rebuilt or replaced. The diesos did this.

Nearly all this work was done by our four diesos (David Blaby, Michael Webb, and Ron Gomez were Senior Diesel Mechanics, while Jack Turner was Plant Inspector, but we referred to them all as diesos). All of them possessed almost magical mechanical skills.

We also had some expected tasks: mounting our equipment in the new Nodwell; assembling the supplies and equipment needed for living out on the icecap for months; and testing of the final gear before leaving. I did most of this, helped by Roger Harrison, the technician sent by the Bureau of Mineral Resources to help with the project, and George Suckau, the technician responsible for maintaining our ice radar, as well as operating the instruments at Casey associated with an ionospheric research project.

Much of this preparation had to be done in the open (the Nodwells would not fit into the workshop), and we were hampered by blizzards (on February 24, 25 and 26, March 5 and 6). It took until March 16 for us to complete preparations, and we attempted to start that afternoon. But the tow hitch on the leading sledge failed before the sledge moved. Our very capable mechanics designed and constructed a replacement in three hours, but by then visibility had deteriorated to the point where we could not travel, so we did not actually leave Casey for our first field trip until March

Doodlebugger continued on page 27.

Doodlebugger continued from page 26.

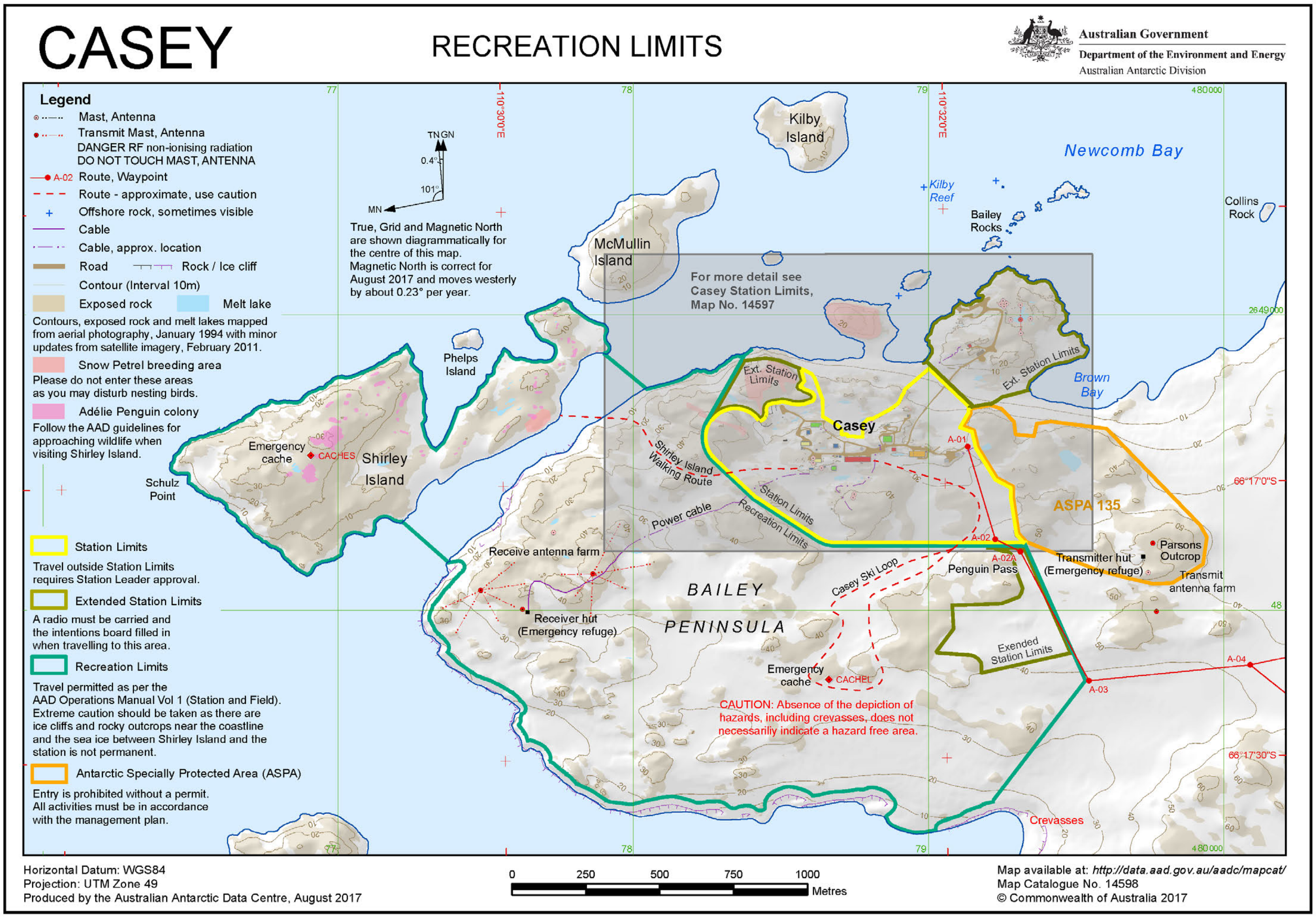

Figure 3: Casey Station location on Bailey Peninsula (By Australian Antarctic Division (Australia) - Map 14598: Casey: Recreation Limits, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=91048374).

17, a month after taking charge of the station, and two weeks later than anticipated. We left Casey at 0845 in fine and sunny weather, as seen on the cover of *Blizzards and Broken Grousers*, with the temperature a few degrees below freezing. I started in the lead, driving the D4 towing a sledge train, with Jay (John Young) as relief driver, and Blue (Alan Phillips) as radio operator and cook. The balance of the field party (the two Nodwells, with David Blaby, George Suckau, and Roger Harrison) left Casey later, at 1430. Gordon McInnes (the Officer In Charge of the wintering party) and Jack Turner accompanied them in the Hotchkiss.

We drove that D4 inland onto the icecap for fourteen hours and covered thirty miles. One step closer to being able to begin the real scientific work... □

Figure 4 Nodwell 110 tracked carrier (https://www.directindustry.com/prod/foremost-industries-lp/product-57851-1388693.html).