

NXT's Brazilian Agent



CEGeo - Centro de Excelência em Geociências

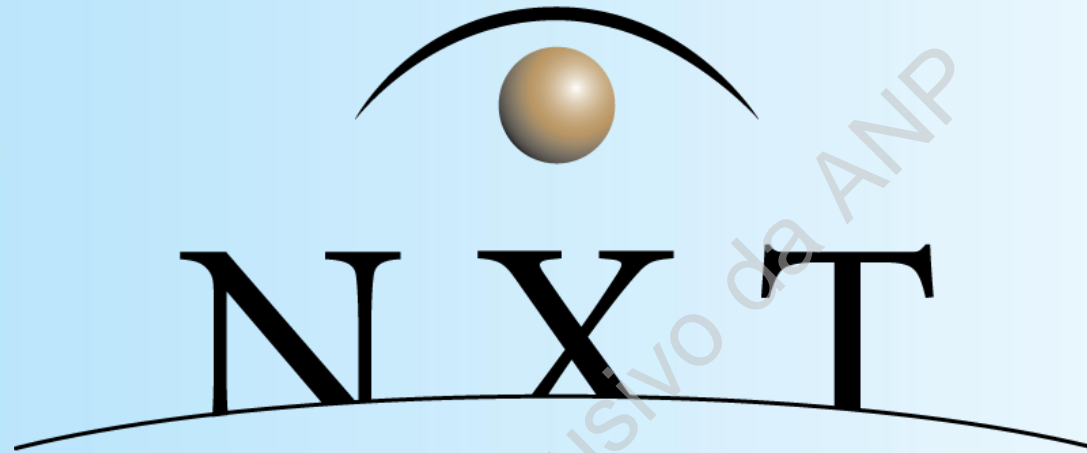
Francisco Celso Ponte Filho

Executive Director

celso@cegeo.com.br

+55 (24) 3302-4258

+55 (24) 99331-5967



Energy Solutions

**General presentation and the case for
utilizing SFD ®**

***A PROVEN, INNOVATIVE TECHNOLOGY FOR
HYDROCARBON EXPLORATION***

NXT Energy Solutions Inc.

is a service provider to the upstream Oil & Gas Industry:

Engaged in exploration reconnaissance.

We identify and rank high-potential prospect leads using a unique airborne survey method.

Expanding worldwide client base.

SFD[®] Survey System

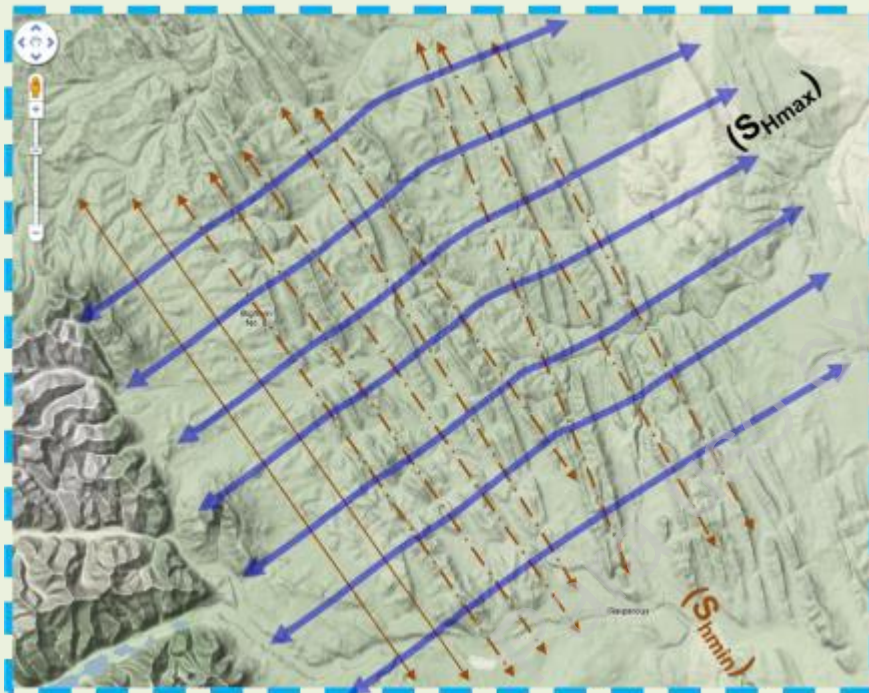


Experience worldwide

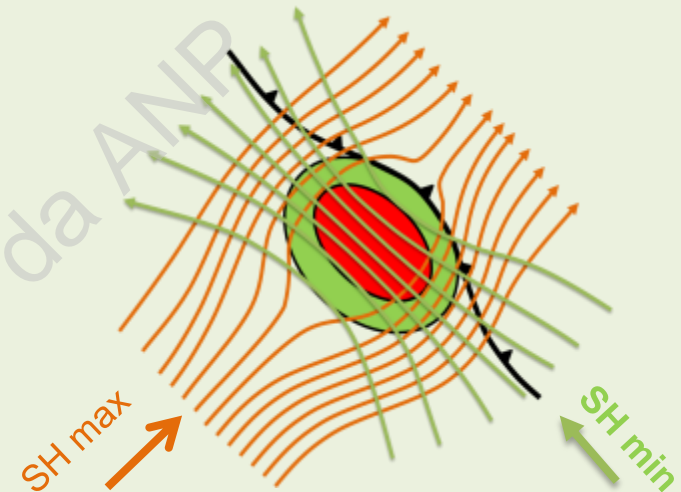


Regional and Local Effects of Principal Stresses

Tectonic impact- *controls regional stress direction*



Regionally - horizontal stresses define the migration pathways, reservoir orientation and fluid expulsion (S. Bell 1996)

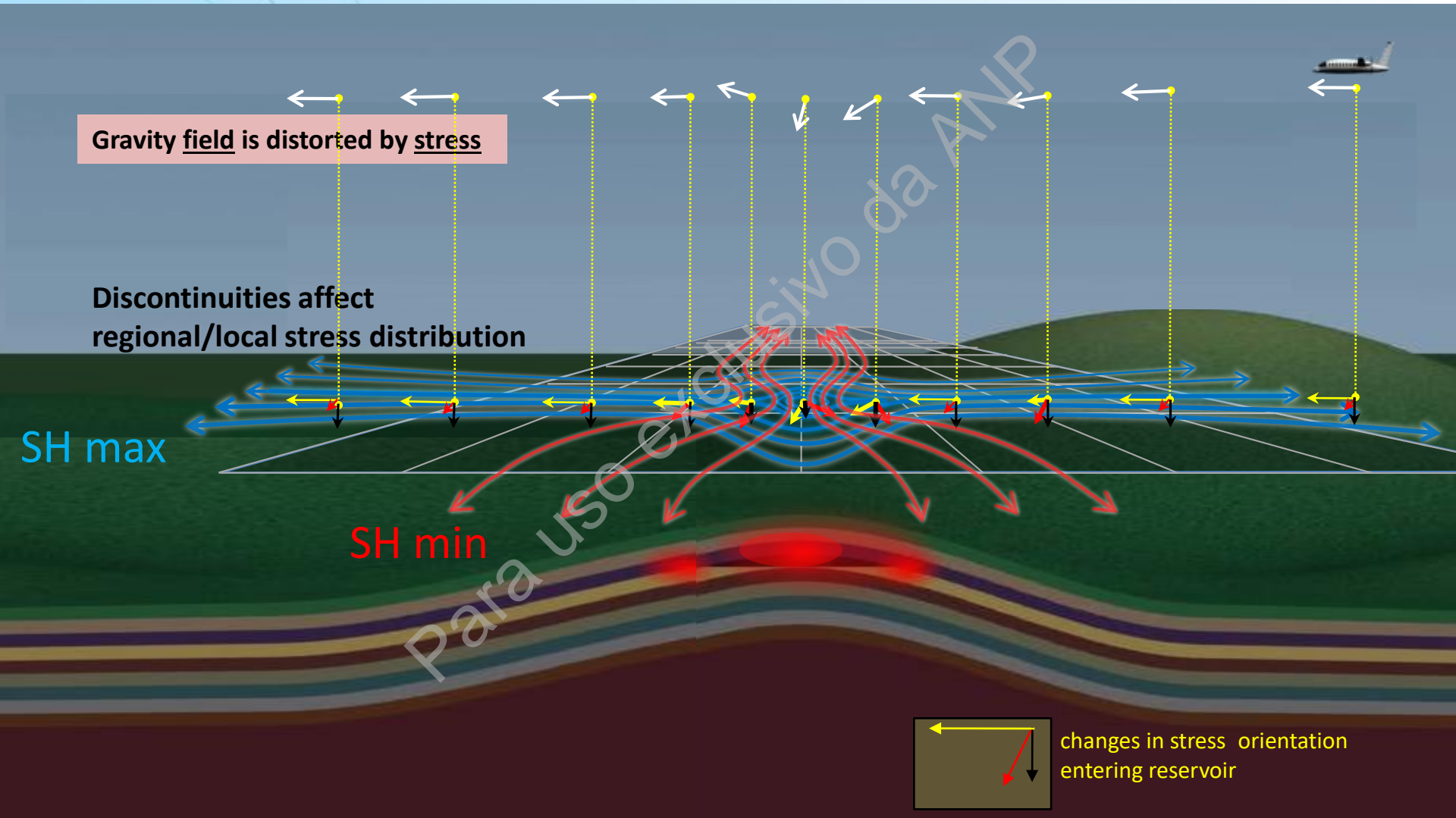


Locally - Principal horizontal stress components are redistributed due to:

- Porosity,
- Trapped fluids,
- Fracturing,
- Faulting,
- Reservoir pressure

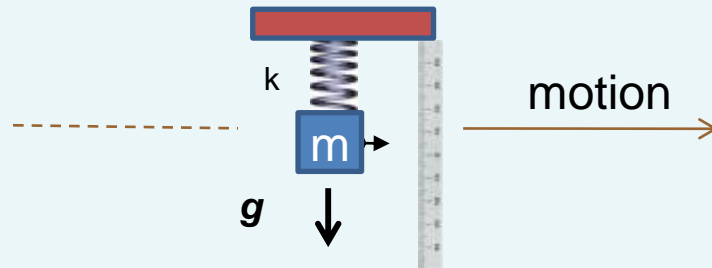
These directional changes indicate a change in stress anisotropy located at the edges of traps

SFD[®] responds to perturbations in the gravity field related to changes in stress direction

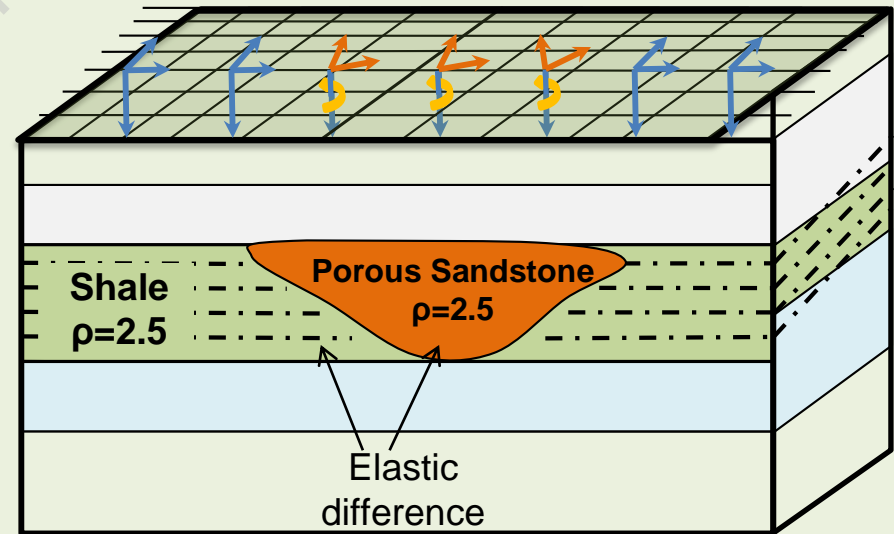
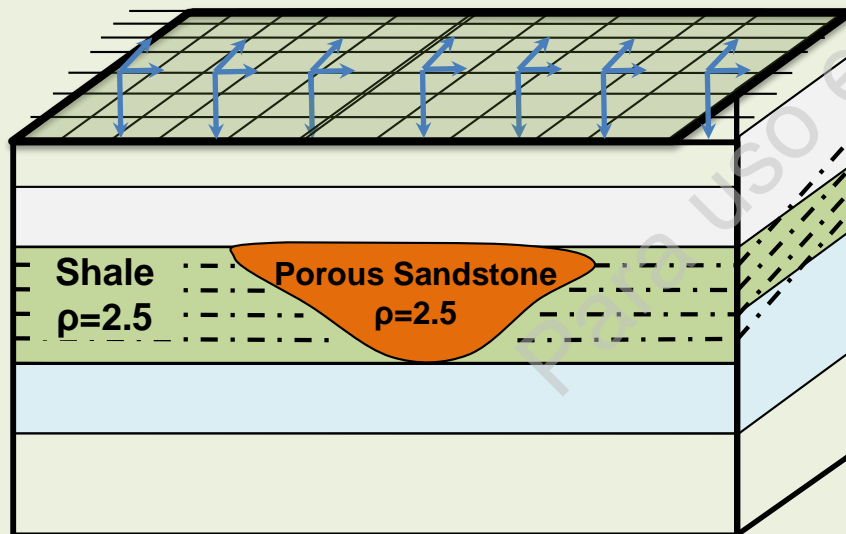
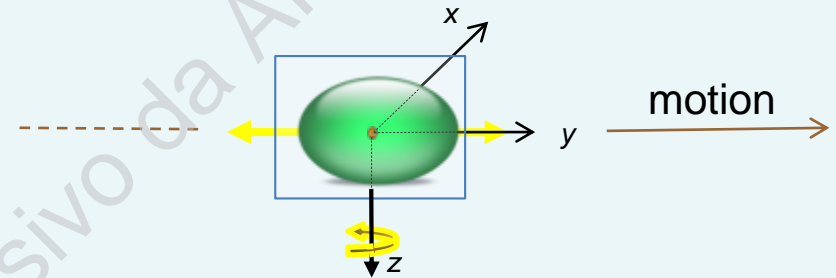


SFD[®] vs. Conventional Gravity or FTG. . . SFD[®] exploits the rotational effects in gravity due to the change in subsurface stress orientations.

Since the porous sandstone and the shale carry the same density ($\rho=2.5$) the gravimeter response will remain unchanged.



The elastic (shear) differences create stress anomalies detectable only by the SFD[®] sensor - as minute gravity field rotational effects.



Confirmation of Conceptual Feasibility

What's New?

Recent scientific advancements validate the premise of using quantum devices for potential field surveys.

DARPA* Research Note, September 20, 2012:


“... micro-scale inertial sensors work like a Foucault pendulum. (the) sensors send out vibrations (and) the precession of a standing wave is measured ...”

* Defense Advanced Research Projects Agency

Institute for Quantum Computing (IQC)

University of Waterloo; Facility Opening – September 2012:

“... Research at IQC aims to harness (the) unique properties of quantum mechanics to build unprecedented technologies, such as ... highly efficient sensors ...”



UNIVERSITY OF MARYLAND

jqi Joint Quantum Institute

JQI has “developed a novel design for a highly compact, ultra-sensitive quantum device to measure subtle changes in gravity using atomic interferometry.”

It may “be used to search for natural resources beneath the Earth’s surface.”

August 2010

Confirmation of Conceptual Feasibility

Similar quantum gravity techniques being applied

JOINT QUANTUM INSTITUTE

HOME ABOUT RESEARCH NEWS EVENTS WORKSHOPS OUTREACH APPLY

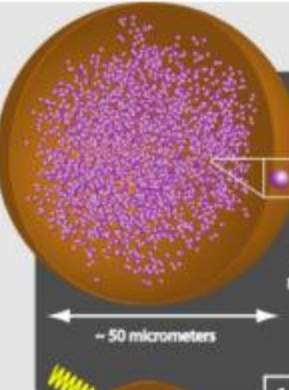
HOME • RESEARCH NEWS

A New Design for a Gravimeter

A NEW DESIGN FOR GRAVITY DETECTION

AUGUST 21, 2010

RESEARCH NEWS



A New Kind of Gravimeter

Theorists have designed a device to detect faint changes in gravitational force using a novel form of atom interferometry based on the recently demonstrated behavior of atoms in a "synthetic" magnetic field. A trap about half the width of a human hair contains millions of atoms, each acting independently.

~ 50 micrometers

Scientists have developed a novel design for a highly compact, ultra-sensitive quantum device to measure subtle changes in gravity over very short time or distance scales."

Tools of this sort – called atom interferometers (AIs) – are now used to search for natural resources beneath the Earth's surface, navigate deep underwater or in the air, and measure Newton's gravitational constant to extraordinary precision. But the new design, by researchers from the Joint Quantum Institute and its Physics Frontier Center, offers the possibility of unprecedented temporal resolution by harnessing the very recently demonstrated ability to create "synthetic" magnetic fields.

"The ability to measure gravity over fine time scales will help in finding oil fields and mineral deposits," says cosauthor and JQI Fellow Victor Galitski. "Imagine an aircraft flying over an unexplored area. If heavy element deposits are hidden underneath, the gravimeter will react promptly by showing strong fluctuations in the local gravity field."

NEWS

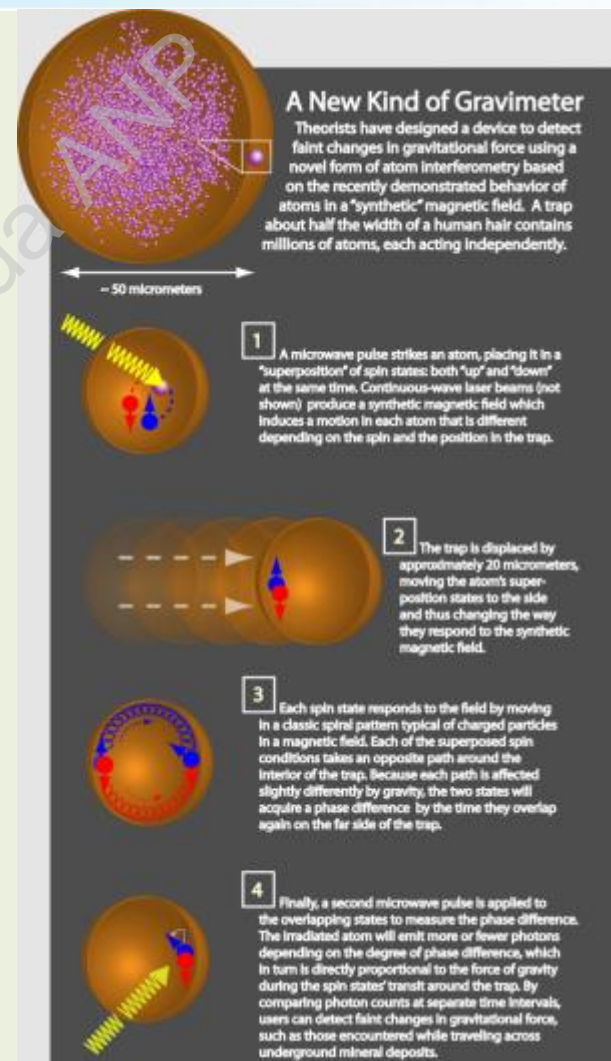
RESEARCH NEWS
PEOPLE NEWS
JQI PODCAST
NEWSLETTERS

RECENT NEWS

- RUDIMENTARY ATOM CAPACITOR
JANUARY 3, 2013
- A NEW PHASE IN READING PHOTONS
JANUARY 6, 2013
- ULTRACOLD MOLECULES TAMED
DECEMBER 19, 2012
- NOBEL WORK CONGRATULATIONS TO DAVID WINELAND AND SERGE HAROCHE
DECEMBER 17, 2012
- DISAPPEARING LIGHT
DECEMBER 5, 2012

PEOPLE NEWS

APS



<http://jqj.umd.edu/news/new-design-gravimeter>

Confirmation of Conceptual Feasibility

Similar quantum gravity techniques being developed

Various research institutions trail in developing similar technological capabilities...

By Jennifer Ouellette

A UK collaboration has built a quantum device dubbed a gravimeter that uses cold atoms to make ultra-precise measurements of the strength of gravity. It could be used to survey for oil or minerals, and it may be [the start of a new commercial sector for quantum devices](#).

The device is essentially a scaled-down version of the method used by the LIGO collaboration to detect gravitational waves made by colliding black holes. In this case, the gravimeter senses subtle changes [in the strength of the gravitational fields](#) generated by any object, using clouds of cold rubidium atoms as sensors. These clouds of atoms are held aloft in a basketball-sized vacuum chamber and cooled down to 80 microkelvin – barely above absolute zero.

The atoms are put into a superposition, where they're in two states at once – think Schrodinger's cat, both alive and dead – until a measurement is made. Then the atom clouds are dropped, and while in freefall, zapped with three laser pulses. Those pulses serve as a kind of ruler made of light, measuring the position at those key points in time before the clouds come back together to make what's called an interference pattern. That pattern is much like what you'd see if you dropped two stones in a pond and they created separate ripples that cross and interfere with other. Here, it encodes the position of the atom clouds and their paths.

Spot the difference

If two atom clouds fall at different speeds, it would indicate a change in the density of the ground below. This could be due to the presence of oil or certain minerals, for example. "Essentially it relies on the fact that any mass will generate a gravitational field, which can be detected with a very precise gravity sensor," says [Kai Bongs](#) at the University of Birmingham, who helped develop the device.

Quantum effects disappear when exposed to any outside interference or noise, so any quantum system or device must be carefully shielded and [cooled to very low temperatures](#). This has limited their use in many real-world applications. But times are changing.

"We're starting to see this technology maturing into the commercial domain," says [Graeme Malcolm](#), founder and CEO of photonics company M Squared in Glasgow, which developed the gravimeter with a team at the University of Birmingham. That's why the oil and gas industry could be particularly interested in the gravimeter. It could be a powerful tool to help map out valuable deposits of oil or minerals, because denser materials will have a stronger gravitational pull than open pockets beneath the earth.

New Scientist

HOME NEWS TECHNOLOGY SPACE PHYSICS HEALTH EARTH HUMANS LIFE TOPICS EVENTS JOBS

<https://www.newscientist.com/article/2142507-quantum-gravity-detector-will-use-atom-clouds-to-survey-for-oil/>

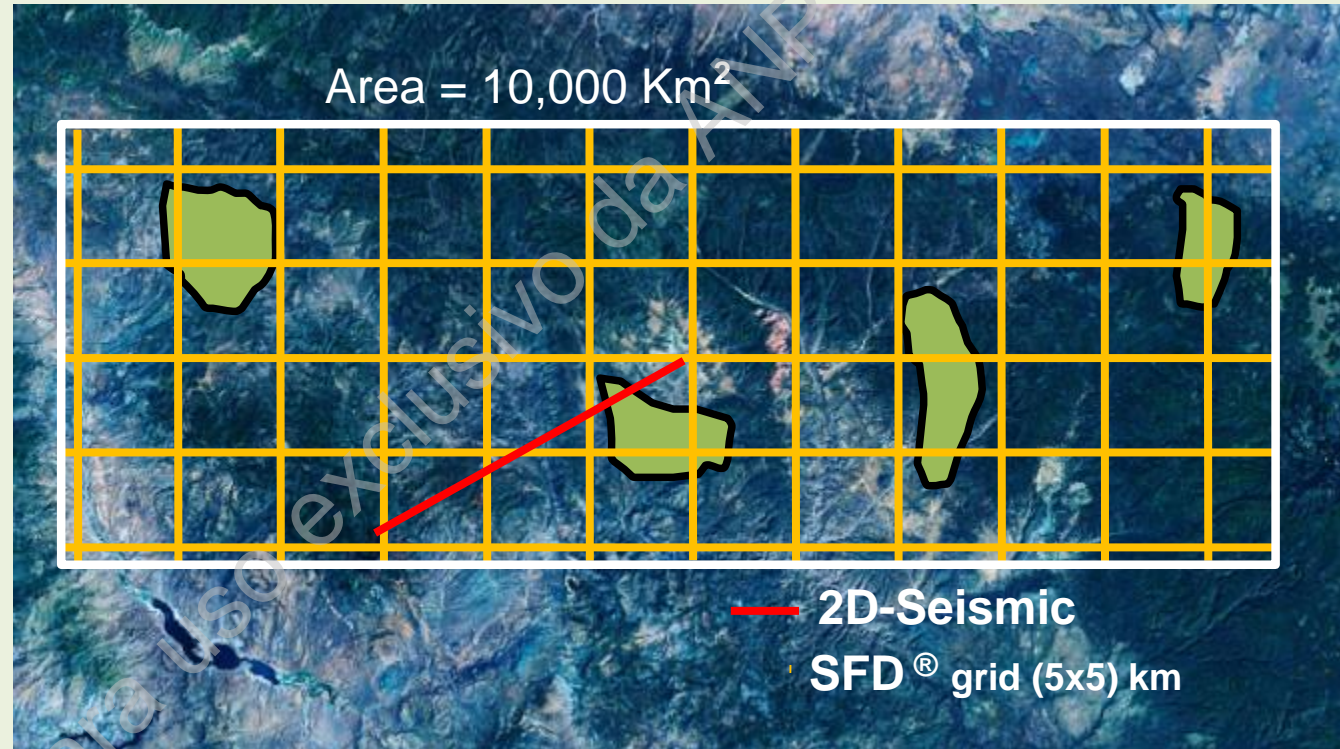
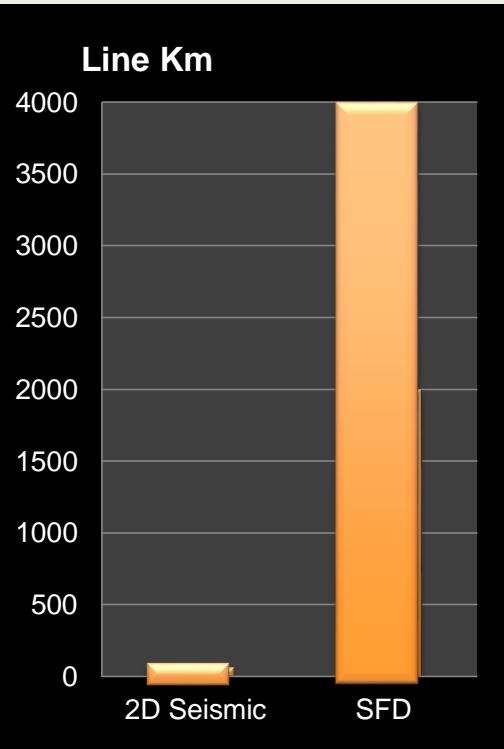
Quantum gravity detector will use atom clouds to survey for oil



A quantum detector that can discern subtle differences in gravity could be about to make waves.
Alamy

Advantages of utilizing SFD[®]

Prospect *Identification*



SFD[®] - Allows exploration efforts to be focused on areas of greatest prospectivity, as indicated by SFD[®] anomalies. Much larger coverage is possible, much more quickly, and with no environmental footprint. Avoids ignoring leads of interest due to limited coverage. Reduces overall time and costs of an exploratory campaign.

Advantages of utilizing SFD®

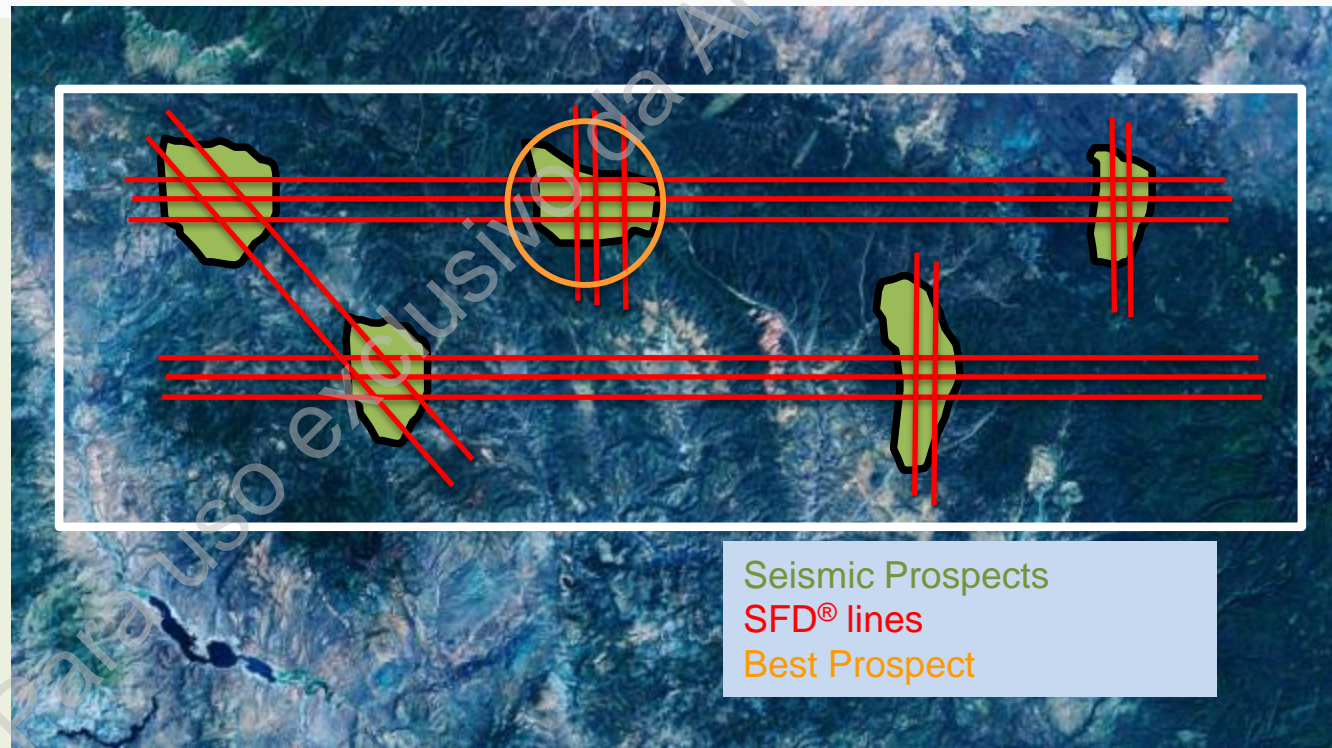
Prospect **Verification**

Offshore Coverage

Prospects initially identified by seismic

SFD® evaluates reservoir potential of prospects

Data integrated to choose best prospect and to minimize drilling risk



SFD® quickly and cost effectively evaluates seismically identified prospects for reservoir potential – reducing drilling risk (dry hole risk).

SFD® Track Record

Positive and Negative Indications

SFD® Recommendations vs. Discovery

NXT conducted **10** surveys for **5** clients
totalling more than **7,000** line kilometers

Wells drilled on SFD®
recommended leads

11

Wells drilled in areas
rejected by SFD®

12

4 Field
Discoveries

*Estimated 1.26
Billion BBL OOIP*

← **7/11**

**Commercial
discoveries**

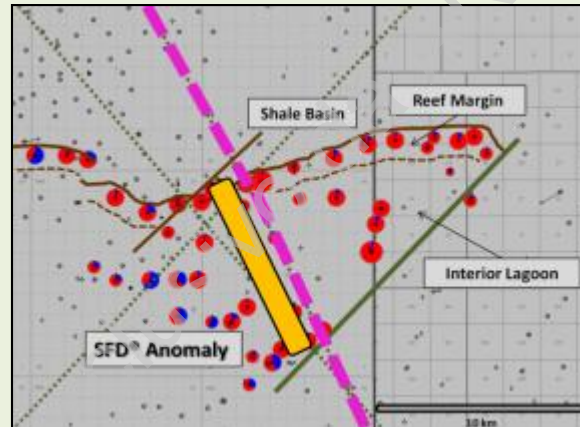
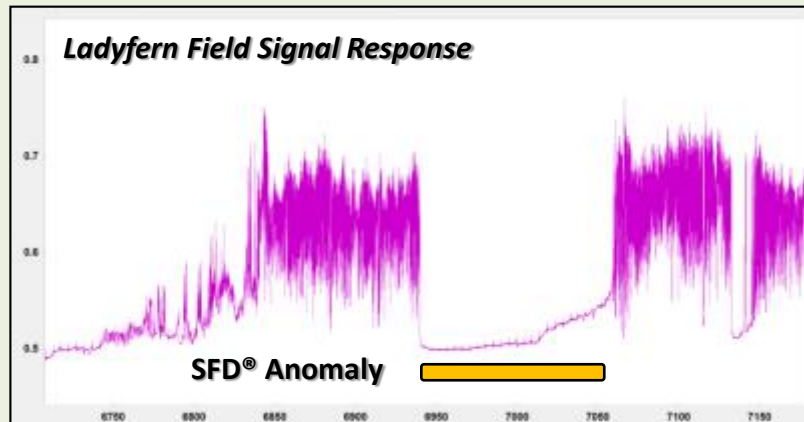
0/12 →

64%

**Prediction
Success Rate**

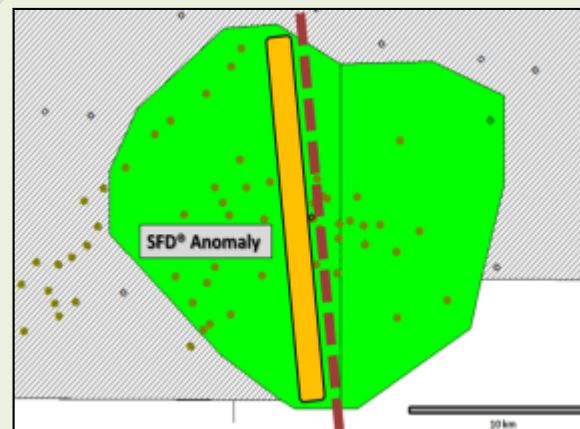
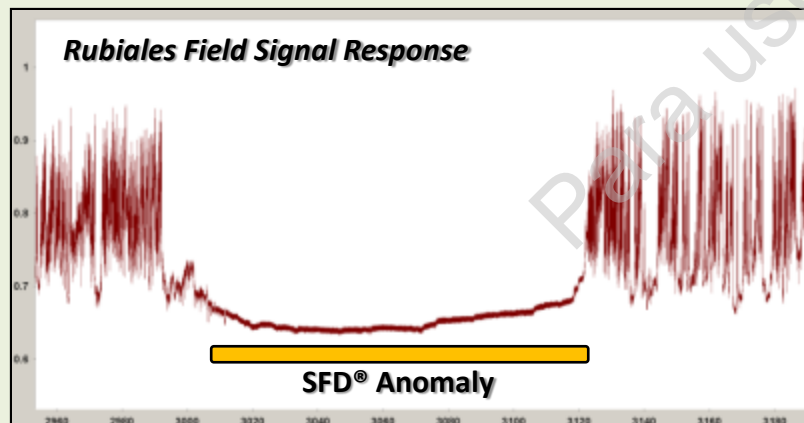
100%

Confirmation of Technical Capability of Positively Identifying Fluid Accumulations



**SFD® signal over
Ladyfern Field,
Canada**

1.62 Trillion cu. ft. Rec.

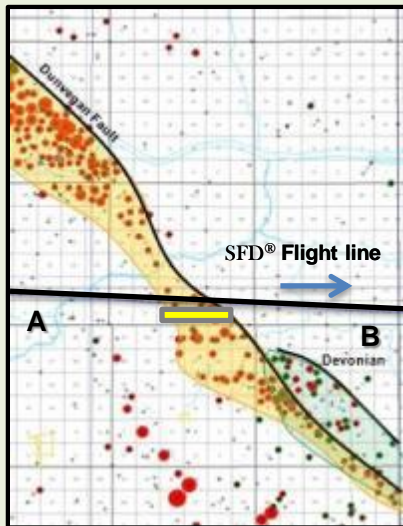


**SFD® signal over
Rubiales Field,
Colombia**

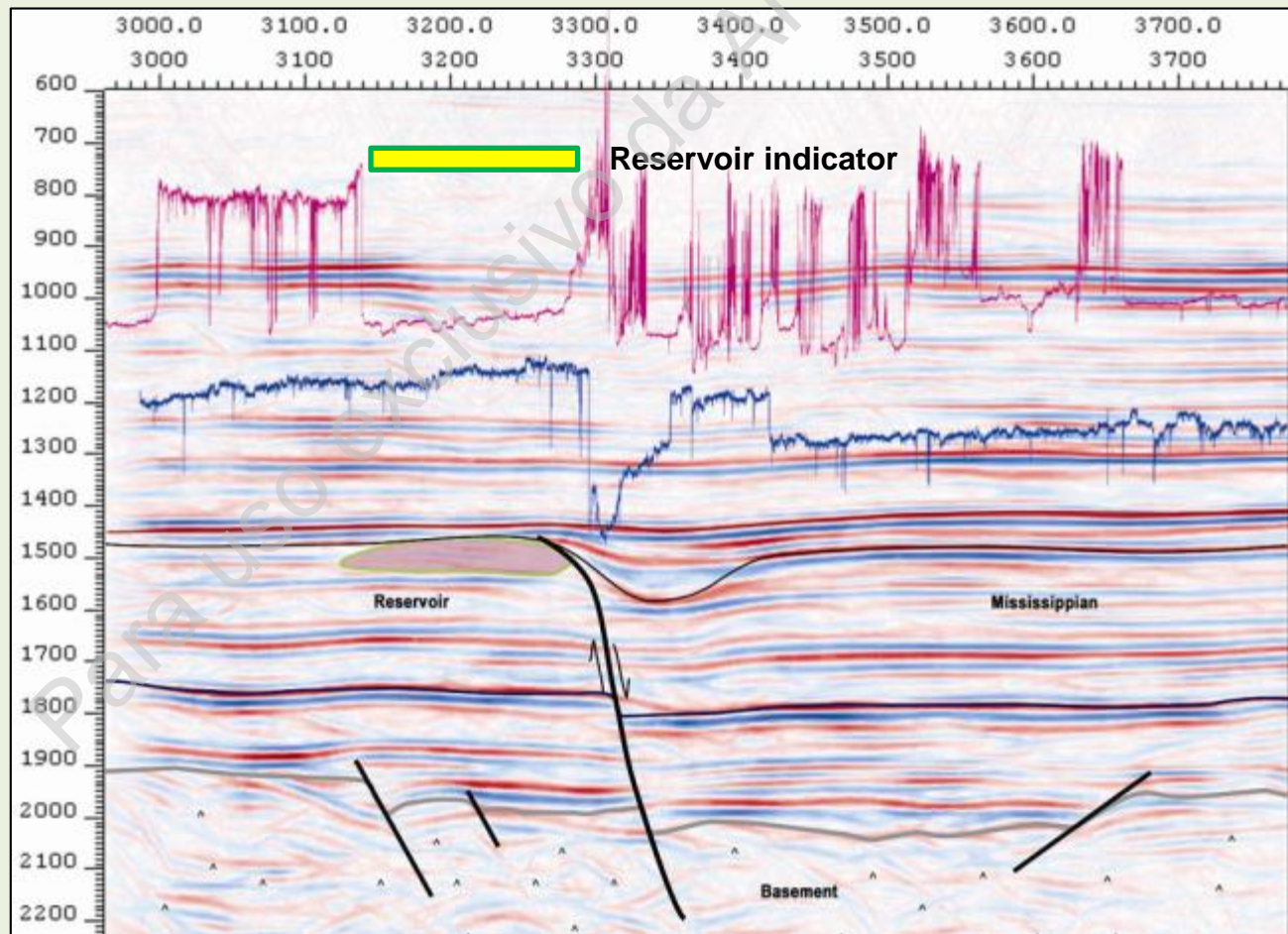
500 million bbls Rec.

Confirmation of Technical Capability of Positively Identifying Fluid Accumulations

Dunvegan–Debolt Fm. Fault Bounded Trap - Seismic-to-SFD® Correlation

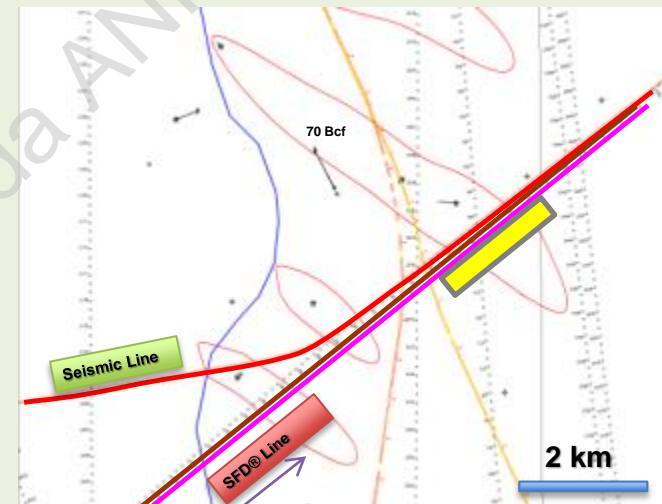
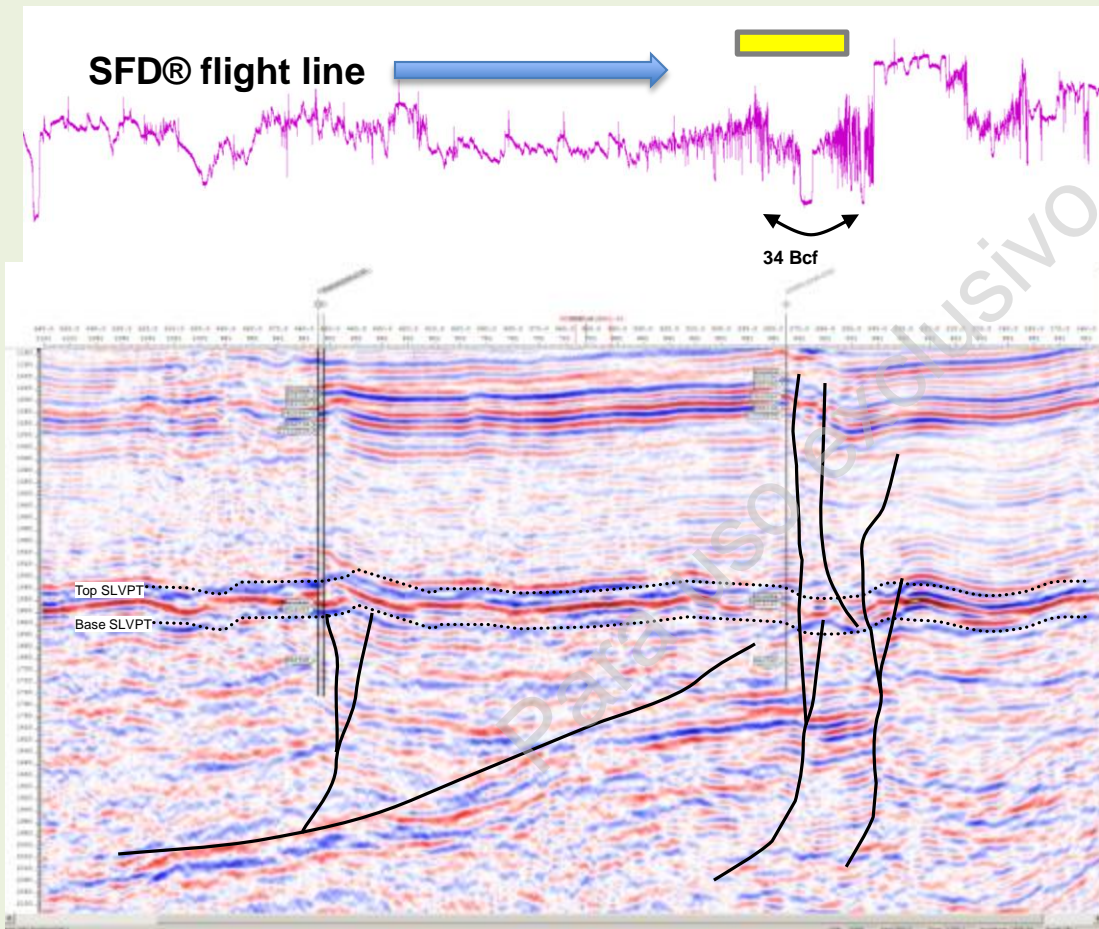


Dunvegan Field in Alberta Canada has produced 1.1 Tcf of gas from Mississippian Debolt formation with additional light oil production from Devonian carbonates. The area is still under development drilling and new pools are found within deeper zones related to faulting.



Confirmation of Technical Capability of Positively Identifying Fluid Accumulations

Canadian Plains Fractured Carbonate Adsett Gas Field



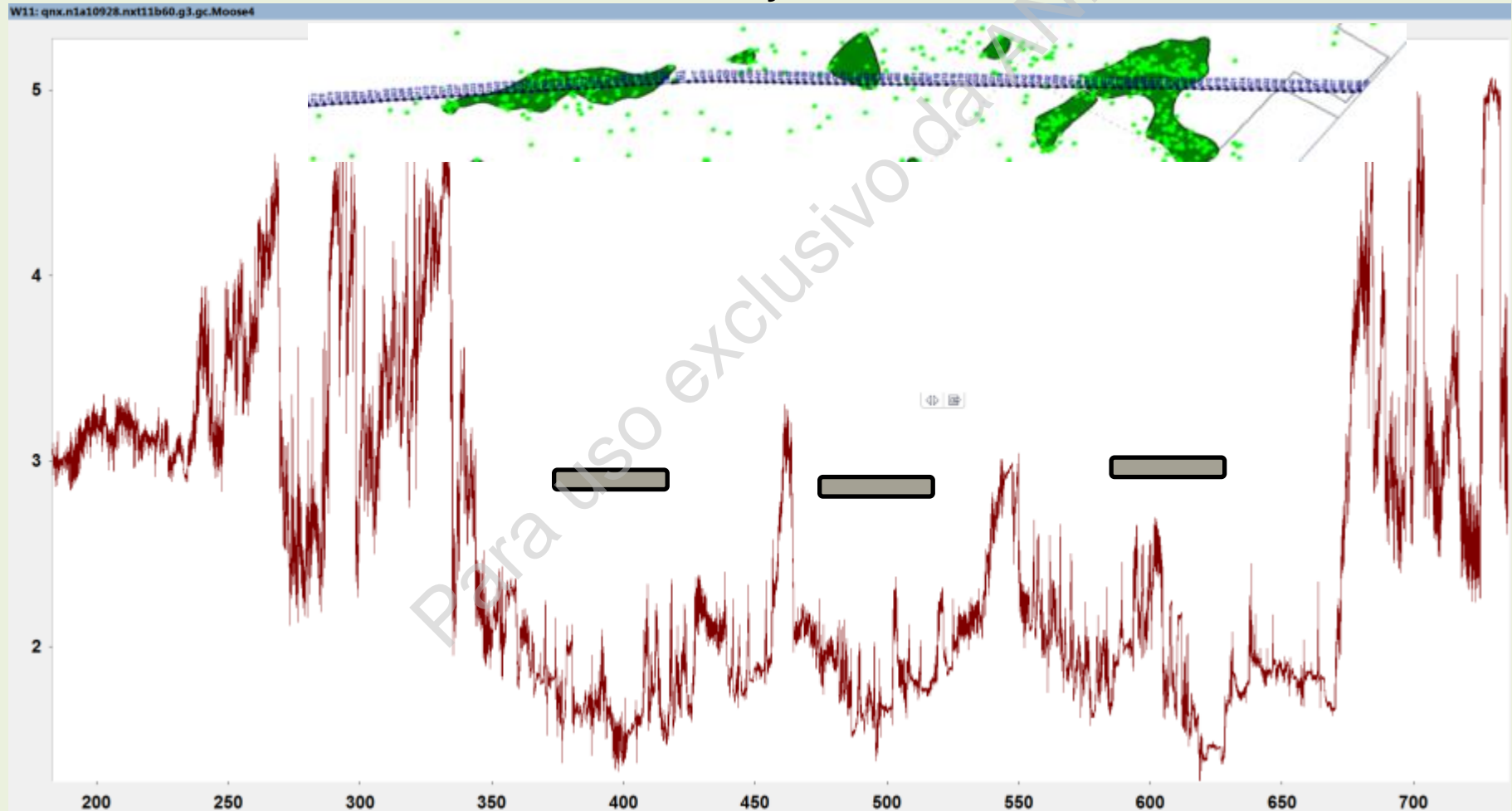
Adsett Main Pool

Adsett pool comprises of a series of hydrothermal dolomite bodies associated to collapse of Slave-Point Carbonate Bank due to Hydrothermal fluids as depicted by the model below.

Deeper normal faults are key to the movement of fluids causing karsting and collapse of the bank

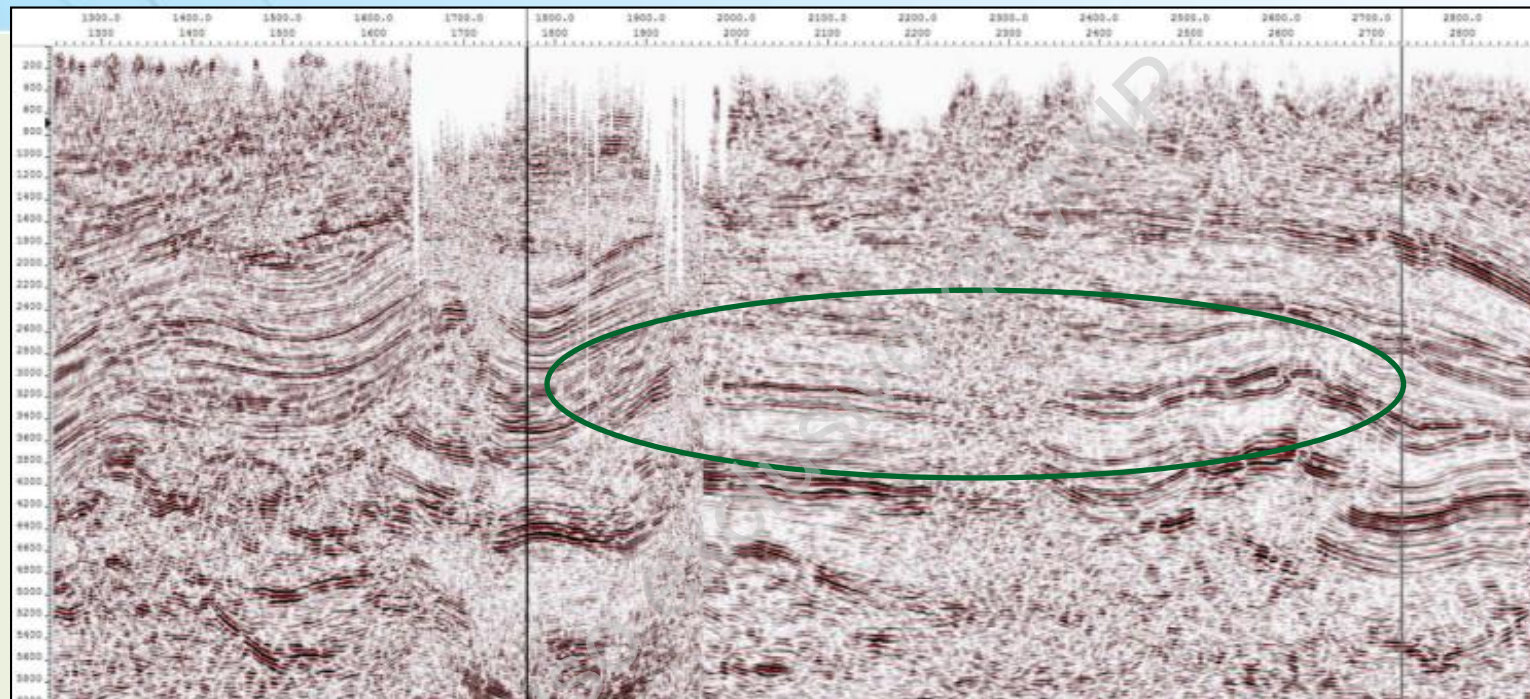
Confirmation of Technical Capability of Positively Identifying Fluid Accumulations

GOM shelf production – 99% of known reserve volumes in 64 accumulations were successfully identified



Confirmation of Technical Capability of Positively Identifying Fluid Accumulations

Seismic
3006 -
3450

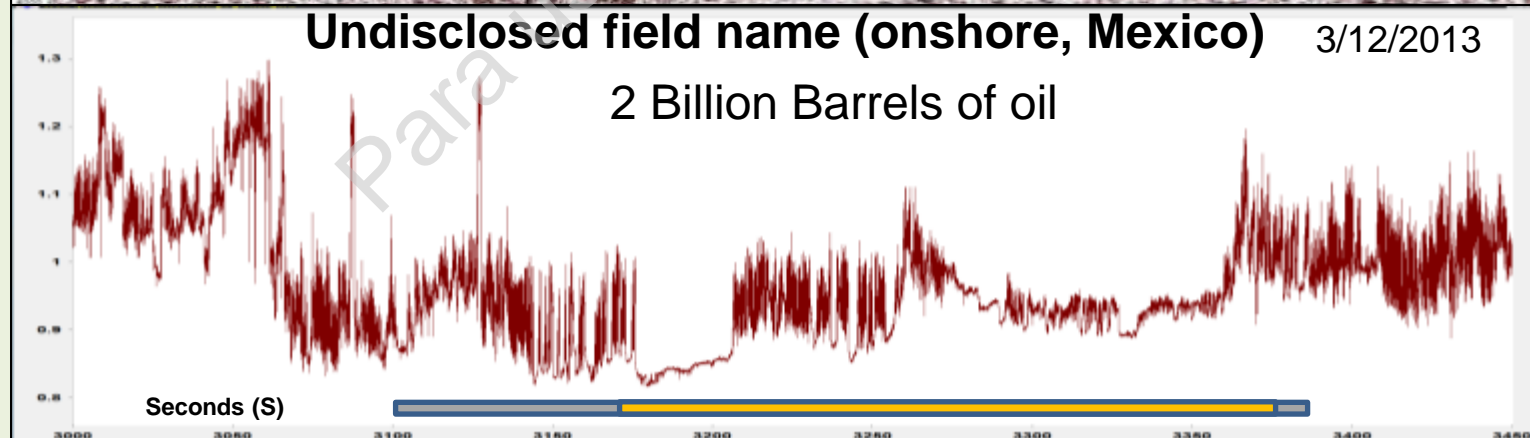


SFD
1.10

Undisclosed field name (onshore, Mexico)

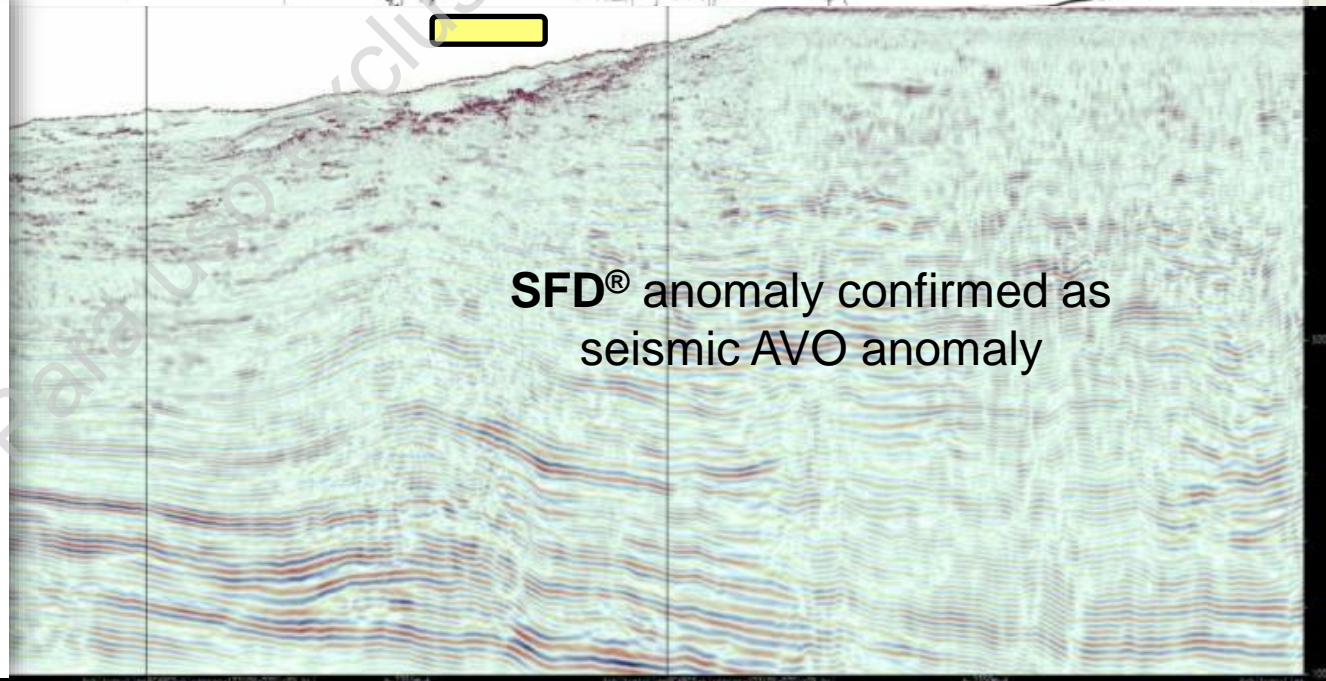
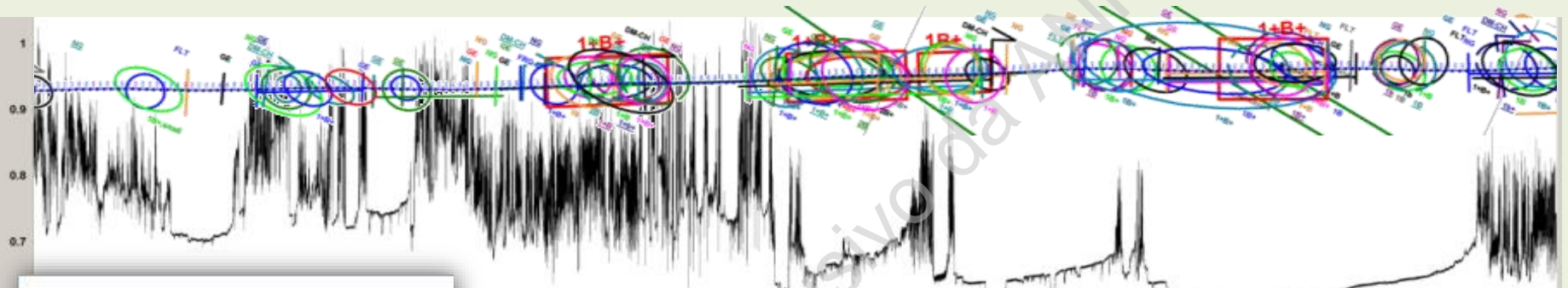
3/12/2013

2 Billion Barrels of oil



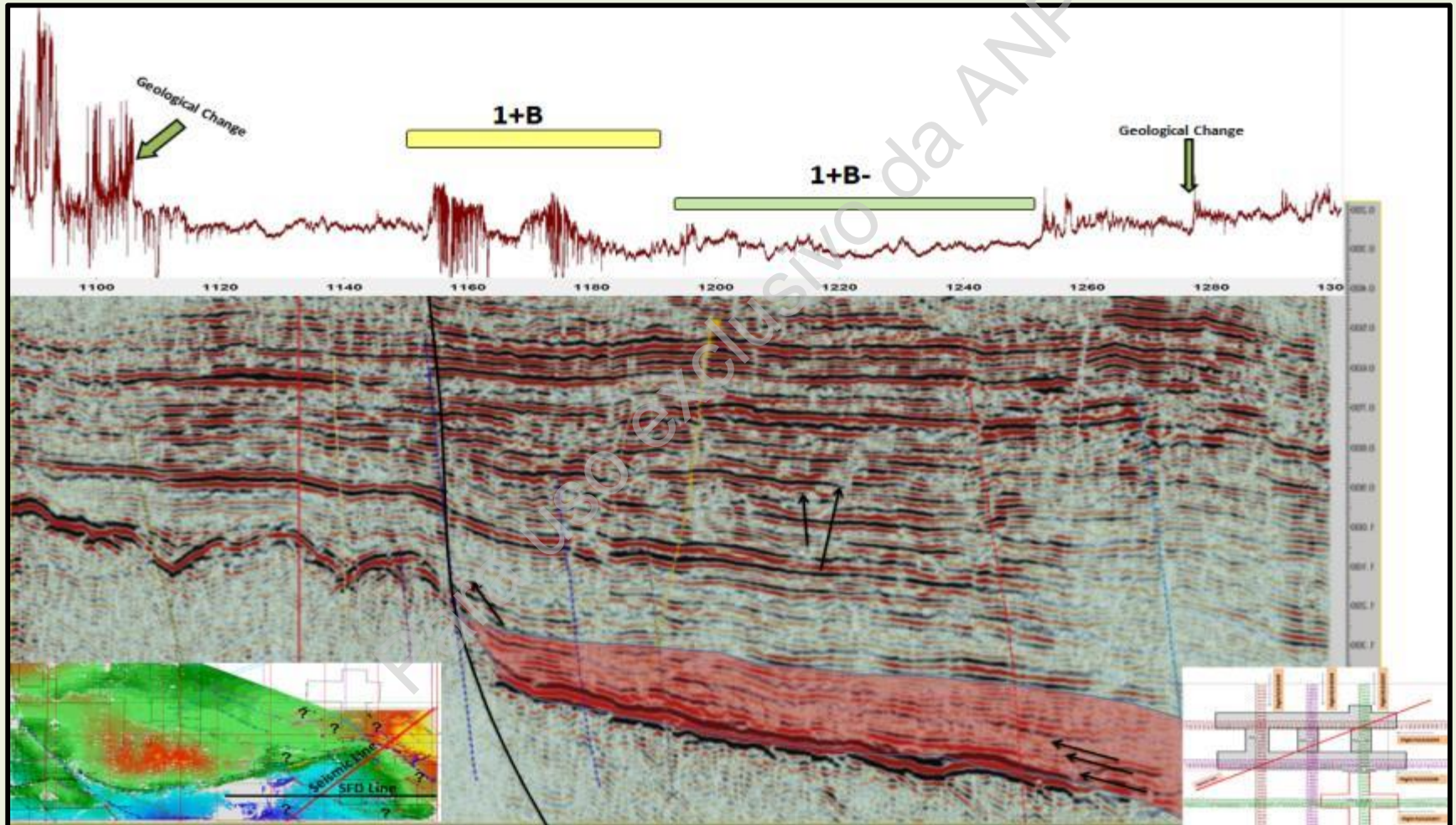
Confirmation of Technical Capability of Positive Correlation with Advanced Seismic Anomalies

Offshore Turbidites - Blind Test for British Petroleum



SFD® anomaly confirmed as seismic AVO anomaly

Argentina: SFD[®] Recommended Area with High Seismic-to-SFD[®] Correlation



NXT's Brazilian Agent



CEGeo - Centro de Excelência em Geociências

Francisco Celso Ponte Filho

Executive Director

celso@cegeo.com.br

+55 (24) 3302-4258

+55 (24) 99331-5967