Introduction

define

location

1826

International Association of Oil & Gas Producers

Aim of This Webinar

- To provide a high-level overview of the SEG-Y v2.1 format

- To show how the embedding of structured metadata such as the IOGP P-Formats enables automation and overcomes the limitations of EBCDIC header records

International Association of Oil & Gas Producers

How did we get here?

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
SEG			▲ SEG-Y																									
IOGP*												▲ P1/84						▲ P1/90				▲ P6/94				▲ P6/98		
OSDU																						EPSG Registry Published						

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
SEG		▲ SEG-Y Rev 1															▲ SEG-Y Rev 2						▲ SEG-Y Rev 2.1					
IOGP*												▲ Px/11 Rev 1			▲ Px/11 Rev 1.1									▲ Px/11 Rev 2				
OSDU																				▲					▲			

OSDU Release 1   OSDU Release 25

Automation and Interoperability

Key: ▲ SEG Release   ▲ IOGP P1/P6 Release   ▲ OSDU Release

*IOGP took over the responsibility for P Formats from UKOAA in 2005 when the Geomatics Committee was formed.

SEG-Y: History and Format Overview

SEG-Y_r2.1 (auto-readable via xml) and P Format data

The aim of the SEG-Y_R2.1 format is to create an auto-readable volume with embedded positioning data and random access to the sample level

- Textual Header (EBCDIC or ASCII)

- Binary Header
  - Including new flags
    - Additional textual headers are present
    - All traces are the same length

- Additional Textual Headers (3200 byte headers)
  - Xml (keyword value pairs of key trace header entries) – auto-read of data volume
  - P6/11 or P1/11 according to data types

50 Years Struggling to Read SEGY data

- Original Formats 1975
  - No marine
  - Little or no memory
  - Little or no disk
  - No 3D

- Update SEG-Y_r1 2002
  - Little or no adoption
- Update SEG-Y_R2.0
  - Little or no adoption

Key Values and Benefits to the Industry

MOU Signed between SEG and OSDU

THE SEG FORMATS WILL REMAIN THE INTERNATIONAL EXCHANGE STANDARDS

Key Values and Benefits to the Industry

- A True Exchange Format and Binary Printed Standard

- Description at Bit Level

- Addresses Modern and Future Technology

- Open Source Readers

- Embedded Metadata in Structured Formats

- Positioning Metadata in Industry Standard Formats

Key Values and Benefits to the Industry

New Data Types

- Ultra High-Resolution Data – Shallow Seismic

- 4D

- CCS 4D Monitoring

- Passive

- AI and ML

Time Delays In Data Management

Data Managers spend 60% of their time finding, updating, adding metadata, populating navigation, identifying CRS - ensuring the data is fit for purpose

(a large % of a data managers job)

Cost of Data Management In Seismic

Data Management Cost Per Centre:

- Average Number Of People = 60,000
- Cost per person per year = 150,000 dollars
  - Total 9 Bn
- Cost of Software = 2 bn dollars

Digital Transformation

Is it really Digital Transformation
if you cannot read the data digitally?

e.g. Without Human Intervention

The Progression Of SEG-Y
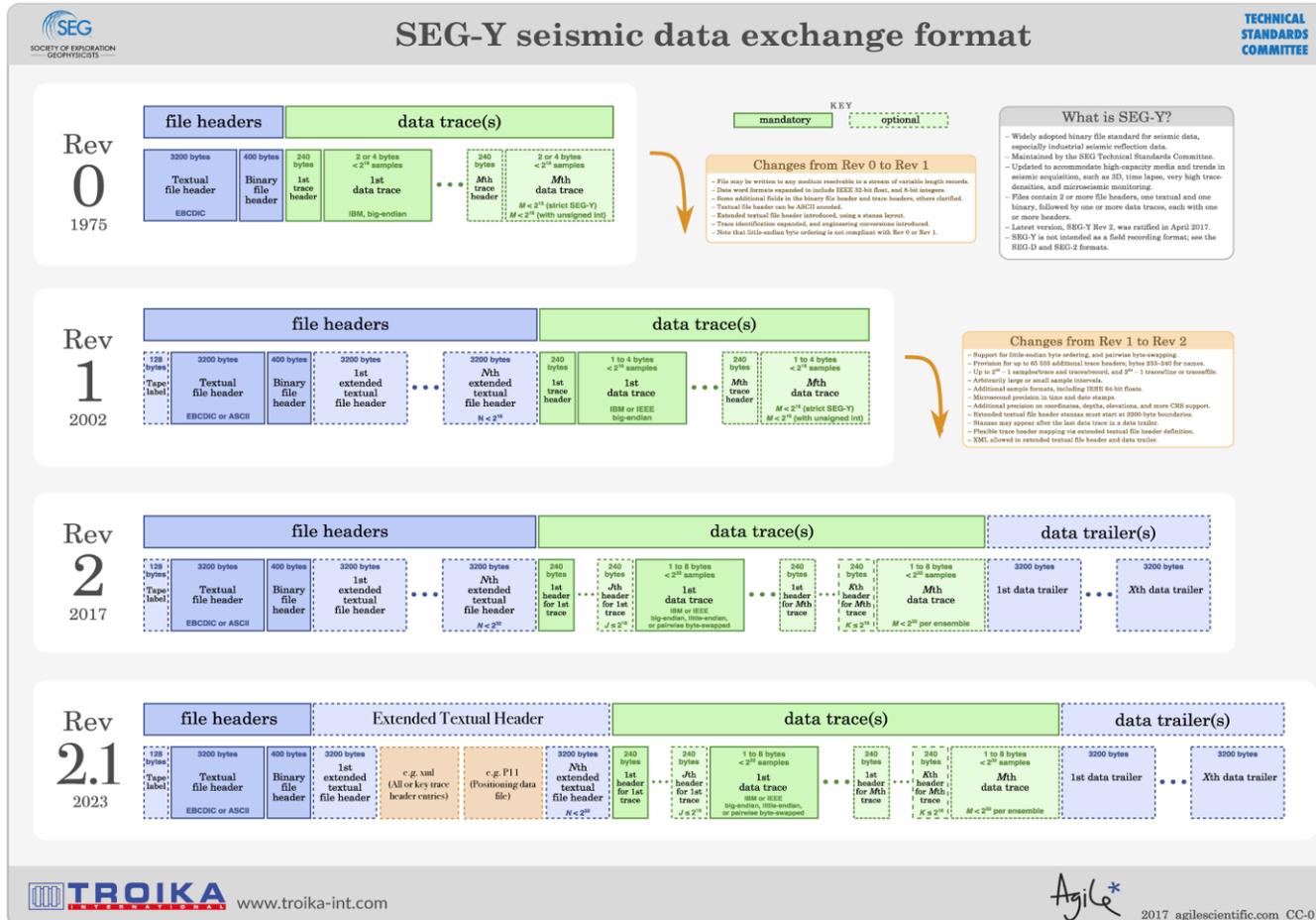
Why Is SEG-Y_r2.1 Different

Moving SEG-Y towards automated readability

```
C01 AREA    : Taranaki_Basin - INGLEWOOD-3D Migration
C02 DESCRIPTION:  3D SEISMIC COVERAGE
C03 SURVEY: INGLEWOOD-3D
C04 INLINE: 1001 - 1360 CROSSLINE: 1 - 227 CDP: 1001001 - 1360227
C05 SAMPLE RATE:  2000 RECORD LENGTH: 4000     CLASS: 3D SEISMIC
C06=================================================================
C07 THIS DATASET HAS BEEN COMPILED FROM A RANGE OF OPEN FILE SEISMIC DATA,
C08 COORDINATES CONVERTED TO A STANDARD PROJECTION AND WRITTEN IN SEGY FORMAT.
C09=================================================================
C10 THIS DATASET WAS PREPARED AND COMPILED BY NEW ZEALAND PETROLEUM AND
C11 MINERALS (NZP&M), 15 STOUT ST, WELLINGTON, 6140, NEW ZEALAND.
C12
C13 THIS DATA IS PROVIDED ON A "AS IS" BASIS AND ALTHOUGH DATA HAS BEEN
C14 MODIFIED BY NZP&M, NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE BY
C15 NZP&M AS TO THE ACCURACY OF THE DATA OR RELATED MATERIALS, ITS
C16 COMPLETENESS OR FITNESS FOR PURPOSE. IN NO EVENT WILL NZP&M, ITS
C17 EMPLOYEES, AGENTS OR CONTRACTORS BE LIABLE FOR ANY LOSS COSTS OR DAMAGE
C18 ARISING FROM ANY PARTIES USE OR RELIANCE ON THE DATASET INCLUDING ANY
C19 CONSEQUENTIAL, SPECIAL, INDIRECT, INCIDENTAL, PUNITIVE OR EXEMPLARY
C20 DAMAGES, COSTS, EXPENSES OR LOSSES. NZP&M WILL NOT ACCEPT ANY
C21 LIABILITY FOR THE CONSEQUENCES OF ANY PARTY ACTING ON THIS INFORMATION.
C22=================================================================
C23
C24 SEG Y REV 21
C25
C26
C27 POINTS USED FOR  ! INLINE 1001   XLINE 1  1704047E  5669430N
C28 SURVEY DEFINITION! INLINE 1001   XLINE 227  1710440E  5667175N
C29               ! INLINE 1360   XLINE 227  1706858E  5657020N
C30=================================================================
C31 TRACE HEADER BYTE LOCATIONS:
C32 INLINE          :BYTES 13-16    XLINE          :BYTES 17-20
C33 CDP            :BYTES 21-24    FOLD           :BYTES 31-32
C34 CDP X COORD METRE  :BYTES 73-76    CDP Y COORD METRE :BYTES 77-80
C35 CDP ELEVATION     :BYTES 81-84
C36=================================================================
C37 PROJECTION : NZTM
C38 DATUM     : NZGD2000
C39 DATE      : APRIL 2013
C40 EXCEL GEOPHYSICAL SERVICES (NZ) LTD   www.excelgeo.co.nz
```

VS

```xml
<?xml version="1.0" encoding="utf-8"?>
<segy-layout name="rev2">
    <desc>SEGY Rev 2 standard entries</desc>
        <entry name="linetrc" byte="1" type="linetrc"/>
        <entry name="reeltrc" byte="5" type="reeltrc"/>
        <entry name="ffid" byte="9" type="int4"/>
        <entry name="chan" byte="13" type="int4"/>
        <entry name="espnum" byte="17" type="int4"/>
        <entry name="cdp" byte="21" type="int4"/>
        <entry name="cdptrc" byte="25" type="int4"/>
        <entry name="trctype" byte="29" type="int2"/>
        <entry name="vstack" byte="31" type="int2"/>
        <entry name="fold" byte="33" type="int2"/>
        <entry name="rectype" byte="35" type="int2"/>
</segy-layout>
```

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Moving SEG-Y towards automated readability

```
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C15 NZP&M AS TO THE ACCURACY OF THE DATA OR RELATED MATERIALS, ITS
C16 COMPLETENESS OR FITNESS FOR PURPOSE. IN NO EVENT WILL NZP&M, ITS
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C22================================================================
C23
C24 SEG Y REV 21
C25
C26
C27 POINTS USED FOR ! INLINE 1001   XLINE 1  1704047E  5669430N
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C32 INLINE            :BYTES 13-16    XLINE         :BYTES 17-20
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C34 CDP X COORD METRE  :BYTES 73-76    CDP Y COORD METRE :BYTES 77-80
C35 CDP ELEVATION      :BYTES 81-84
C36================================================================
C37 PROJECTION : NZTM
C38 DATUM      : NZGD2000
C39 DATE       : APRIL 2013
C40 EXCEL GEOPHYSICAL SERVICES (NZ) LTD   www.excelgeo.co.nz
```

```
C 1 CLIENT STATOIL      COMPANY FUGRO-SURVEY LTD.
C 2 LINE  ST0299-05002 AREA NOCS 15/9
C 3 REEL NO            DAY-START OF REEL        YEAR    OBSERVER
C 4 INSTRUMENT MFG           MODEL TTS 2        SERIAL NO -
C 5 DATA TRACES/RECORD 96     AUXILIARY TRACES/RECORD      CDP FOLD 48
C 6 SAMPLE INTERVAL 1MS    SAMPLES/TRACE 3000  BITS/IN  BYTES/SAMPLE
C 7 RECORDING FORMAT SEG-D  FORMAT THIS REEL SEG-Y  MEASUREMENT SYSTEM TELEDYNE
C 8 SAMPLE CODE 32 BIT FLOATING PT     FIXED PT     FIXED PT-GAIN   CORRELATED
C 9 GAIN  TYPE  FIXED    BINARY     FLOATING POINT    OTHER
C10 FILTERS: ALIAS  HZ  NOTCH     HZ  BAND  HZ  SLOPE  53/18 DB/OC
C11 SOURCE: SLEEVE GUN        NUMBER/POINT       POINT INTERVAL
C12 PATTERN:                    LENGTH        WIDTH
C13 SWEEP: START     HZ  END     HZ  LENGTH     MS  CHANNEL NO     TYPE
C14 TAPER: START LENGTH      MS  END LENGTH       MS  TYPE
C15 SPREAD: OFFSET 35 M    MAX DISTANCE  1235 M    GROUP INTERVAL 12.5 M
C16 GEOPHONES: 16 PER GROUP    SPACING  12.5 M   FREQUENCY  MFG  MODEL
C17   PATTERN:                   LENGTH        WIDTH
C18 TRACES SORTED BY: RECORD     CDP    OTHER
C19 AMPLITUDE RECOVERY: NONE    SPHERICAL DIV     AGC    OTHER
C20 MAP PROJECTION  UTM 001     ZONE ID 31N    COORDINATE UNITS METERS
C21 PROCESSING CONTRACTOR FUGRO  OFFICE OSLO    DATE AUGUST 2002
C22 PROCESSING HISTORY FINAL SCALED MIGRATED STACK
C23 1)REFORMAT, 96 CHANNELS, 1 MS SAMPLING RATE, 2) TRACE EDIT
C24 3)SWELL NOISE SUPPRESSION,
C25 4)SPHERICAL DIVERGENCE COMPENSATION
C26 5)PARABOLIC RADON DEMULTIPLE,
C27 6)VELOCITY ANALYSIS EVERY 500M, 7)NMO,MUTE,STACK, & SHIFT (+4MS),
C28 8)FXDECON, 9)FX MIGR.(100% OF STACKING VEL.), 10)TV FILTER,
C29 11)SCALING NONE, 14)NAV IN HEADERS/OUTPUT IN SEG-Y FORMAT.
C30 AQUISITION: M/V GEO SEARCHER
C31 RECORDING: 8058 (SEGD) 96 CH, 1 MS, 2000 MS
C32 FIELD FILTERS: LOW-CUT 8 HZ, HIGH-CUT 411 HZ  140 CU INCH SOURCE
C33 VERSION ON THIS TAPE: FINAL MIGRATED STACK.
C34 SHOTPOINT / CDP RELATION,  SP: 1001-1470 / CDP: 2100-3133
C35 SHOTPOINT / CDP RELATION,  CDP = 2SP + 193
C36 SURVEY NAME ST0299 VOLVE SITE SURVEY, LINE NAME ST0299-05002
C37 GEODETIC DATUM ED50(NOR) PROJECTION UTM ZONE 31N CENTRAL MERID.3 0 0.000E
C38 FALSE EASTING: 500000.00E  SPHEROID INT. ORIGO GRID ROTATION IN SECONDS
C39 LOC. OF FIRST FULL FOLD CDP FOR FIRST SHOT 1001 IS CDP NO.2195
C40 END EBCDIC
```

```
C 1 CLIENT=STATOIL,      PROCESSED BY=WESTERNGECO
C 2 LINE ST0202D04-9985
C 3 SURVEY:ST0202 ,   AREA: VOLVE 15/9
C 4 DATAFORMAT: SEG-Y,    DATE:02012008
C 5 DATATYPE: FINAL PZ PSDM STACK FULL OFFSET IN PP TIME
C 6 DATA SHOT BY/VESSEL:GECO ANGLER,  CABLE LENGTH:6000 M  NO OF GROUPS: 240x4
C 7 NO OF CABLES 2,      SOURCE:2,  POP INTERVAL 25.0 M (FLIP-FLOP)
C 8 RCV LINE SPACING: 400 M,    SRC LINE SPACING: 100 M, RECORD LENGTH: 10.2 S
C 9 GEODETIC DATUM: ED-50,     SPHEROID: INTERNAT., PROJECTION: UTM
C10 CENTR. MERID.: 03,        UTM ZONE: 31 N, FALSE EASTING: 500000
C11 FIRST SAMPLE= 0,        LAST SAMPLE= 4500, SAMPLE INTERVAL= 4MS
C12 DIST. BETWEEN INLINES=12.5M, XLINES=12.5M BIN SIZE (I x X):12.5M x 12.5M
C13 INLINE DIRECTION (GRID): 284.0000000 DEGREES (CLOCKWISE FROM NORTH);
C14 X-LINE DIRECTION (GRID): 014.0000000 DEGREES (CLOCKWISE FROM NORTH);
C15 ORIGO(1.1) UTMX:431955.70E;   UTMY:6348582.15N  ;
C16 DATA RANGE INLINES=9985-10369, X-LINES=1932-2536
C17 CORNER1:3D INLINE  9985, 3D XLINE 1932, UTM-X 438727.0, UTM-Y 6475514.4
C18 CORNER2:3D INLINE  9985, 3D XLINE 2536, UTM-X 431401.3, UTM-Y 6477341.0
C19 CORNER3:3D INLINE 10369, 3D XLINE 2536, UTM-X 432562.5, UTM-Y 6481998.4
C20 CORNER4:3D INLINE 10369, 3D XLINE 1932, UTM-X 439888.3, UTM-Y 6480171.9
C21 LIVE DATA POLYGON: (9985,1932);(9985,2536);(10369,2536);(10369,1932);
C22 NAVIGATION SOURCE: P1/90 UKOOA BIN CENTER CELL GRID,
C23 PROCESSING SEQUENCE:
C24 1) REFORMAT 2) NAVIGATION MERGE 3) TRACE EDITING 4) DESIGNATURE/ZEROPHASE
C25 5) TIDAL STATICS 6) RESAMPLE 4MS 7) SWATT 8) HCF 82HZ 9) PZ SUMMATION
C26 10) TAUP DECONVOLUTION 11) 3D KIRCHHOFF DEPTH MIGRATION
C27 12) CONVERSION TO TWT 13) VEL ANALYSIS AND RMO CORRECTION 200M X 200M
C28 14) PRE-RADON MILD DIP FILTER 15) PARABOLIC RADON TRANSFORM DEMULTIPLE
C29 16) 3-41 DEGREE ANGLE MUTE 17) STACK 18) PREDICTIVE DECON AFTER STACK
C30 19) INTERPOLATION TO 12.5M X 12.5M 20) H-MULT DEMULTIPLE
C31 21) INVERSE Q-COMPENSATION 22) OUTPUT TO SEGY FORMAT
C32
C33
C34
C35 HEADER WORD POSITIONS:
C36 INLINE: 189-192          ;  X-LINE: 193-196;
C37 BINX (CDPX): 181-184,      BINY (CDPY): 185-188,
C38 MERID.: 3.0E, SPHEROID: INT.;  ROTATION (AMS): 1245600000,
C39 A POSITIVE SAMPLE CORRESPONDS TO A INCREASE IN ACOUSTIC IMPEDANCE.
C40 END EBCDIC.
```

The EBCDIC header has no industry standard format for the content, which makes it harder to parse programmatically and thus it generally requires manual interpretation

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Moving SEG-Y towards automated readability

```xml
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<segy-layout name="rev2">
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    <entry name="chan" byte="13" type="int4"/>
    <entry name="espnum" byte="17" type="int4"/>
    <entry name="cdp" byte="21" type="int4"/>
    <entry name="cdptrc" byte="25" type="int4"/>
    <entry name="trctype" byte="29" type="int2"/>
    <entry name="vstack" byte="31" type="int2"/>
    <entry name="fold" byte="33" type="int2"/>
    <entry name="rectype" byte="35" type="int2"/>
</segy-layout>
```
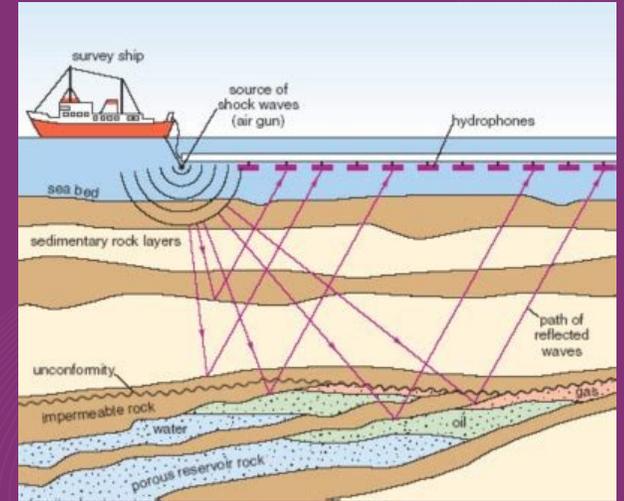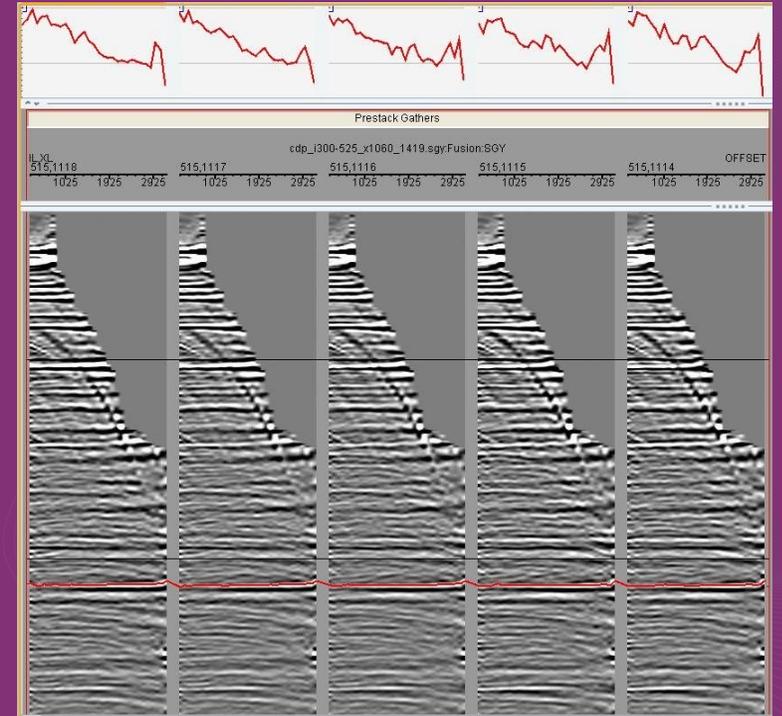
The XML trace header automates loading and avoids erroneous or missing trace header values.

The SEG Technical Standard Committee is working on a standard set of trace header names

What Is Required – Field Data

FOR FIELD DATA

```
<entry name="ffid" byte="9" type="int4"/>
<entry name="chan" byte="13" type="int4"/>
<entry name="espnum" byte="17" type="int4"/>
```

What Is Required – Pre-Stack Data

FOR PRE-STACK DATA

```
<entry name="ffid" byte="9" type="int4"/>
<entry name="chan" byte="13" type="int4"/>
<entry name="espnum" byte="17" type="int4"/>
<entry name="cdp" byte="21" type="int4"/>
<entry name="cdptrc" byte="25" type="int4"/>
<entry name="trctype" byte="29" type="int2"
<entry name="co_scal" byte="71" type="int2"/>
<entry name="sht_x" byte="73" type="coor4"/>
<entry name="sht_y" byte="77" type="coor4"/>
<entry name="rec_x" byte="81" type="coor4"/>
<entry name="rec_y" byte="85" type="coor4"/>
<entry name="coorunit" byte="89" type="int2"/>
```

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What Is Required – Post-Stack

FOR POST-STACK DATA


```
<entry name="cdp" byte="21" type="int4"/>
<entry name="cdptrc" byte="25" type="int4"/>
<entry name "offset" byte="37" type="int4"/>
<entry name="co_scal" byte="71" type="int2"/>
<entry name="sht_x" byte="73" type="coor4"/>
<entry name="sht_y" byte="77" type="coor4"/>
<entry name="rec_x" byte="81" type="coor4"/>
<entry name="rec_y" byte="85" type="coor4"/>
<entry name="coorunit" byte="89" type="int2"/>
<entry name="inline" byte="189" type="int4"/>
<entry name="xline" byte="193" type="int4"/>
```
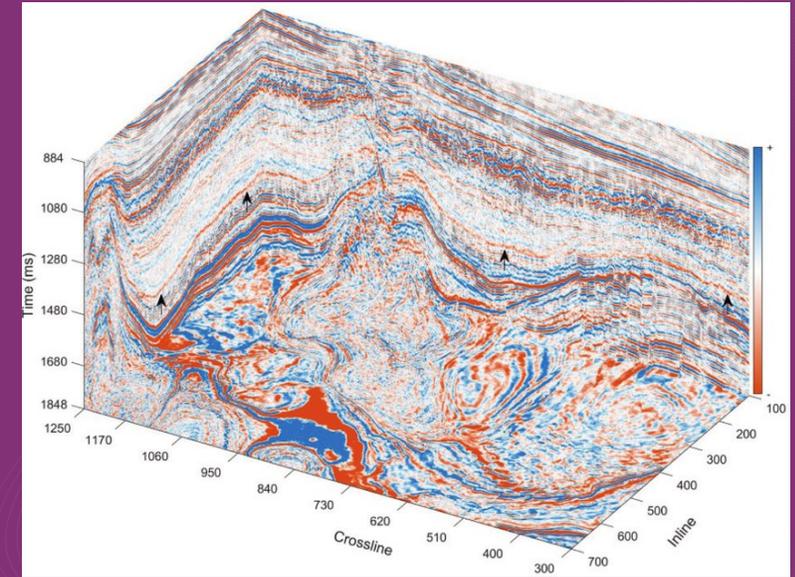
Useful Links

https://library.seg.org/seg-technical-standards

https://library.seg.org/seg-y_rev2-1

https://library.seg.org/seg-y_rev2-1_clarification

https://storage.3.basecamp.com/3710339/blobs/727f6a62

-679c-11f0-aa21-0242ac120005/download/BO_3D-

Inglewood_rev21_v7.sgy.gz?attachment=true

P Formats: History and Format Overview

define

location

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P-Formats

- The P1/11 and P6/11 Formats (Px/11) were issued in 2012 as part of a revision process initiated by IOGP to update a number of standards used by the industry for data exchange.

- The format is maintained with minor revisions having be issued, the current version is v2.01

- P1/11 is the specific positioning format, replacing P1/90

- P6/11 is for bin grid exchange, replacing P6/98
  - Both files have a common header

P-Formats

- The format consists of variable-length comma-separated records written in ASCII

```
IOGP,IOGP P6,6,2.0,1,2024:12:10,15:43:14,BO_3D-Inglewood.p611,IOGP
HC,0,1,0,Project Name                  ,ING3D,INGLEWOOD-3D,2023:03:01,2023:03:30
HC,0,3,0,Geographic Extent            ,0.00,0.00,0.00,0.00
HC,0,4,0,Client                       ,IOGP
HC,0,9,0,Bin Grid Producer            ,IOGP
HC,1,0,0,Reference Systems Summary    ,5,0,4,3
```

P-Format Contents

- Px/11 files contain
  - Survey Summary
  - Geodetic Configuration
  - Perimeters
  - Version History

- P6/11 additionally supports
  - Loading Sheet

Geodetic Integrity

- Px/11 contains a complete definition of the geodetic parameters used during data acquisition.

```
HC,1,0,0,Reference Systems Summary                      ,5,0,4,3
HC,1,1,0,Unit of Measure                                ,1, metre,length,2, , ,                ,   , , metre,9001,EPSG,11.015,9001
HC,1,1,0,Unit of Measure                                ,2,radian, angle,2, , ,                ,   , ,radian,9101,EPSG,11.015,9101
HC,1,1,0,Unit of Measure                                ,3,degree, angle,2,2,0,3.14159265358979,180,0,degree,9102,EPSG,11.015,9102
HC,1,1,0,Unit of Measure                                ,4, unity, scale,2, , ,                ,   , , unity,9201,EPSG,11.015,9201
HC,1,1,0,Unit of Measure                                ,5, (bin), scale,2,4,0,                1,  1,0, (bin),1024,EPSG,11.015,1024
HC,1,1,1,Example Unit Conversion                         ,1,2,1,3,57.29577951
HC,1,3,0,CRS Number/EPSG Code/Name/Source                ,1,2193,NZGD2000 / New Zealand Transverse Mercator 2000,11.015,2024:08:07,EPSG,
HC,1,3,0,CRS Number/EPSG Code/Name/Source                ,2,4167,                        NZGD2000,11.015,2024:08:07,EPSG,
HC,1,3,0,CRS Number/EPSG Code/Name/Source                ,3,4326,                        WGS 84,11.015,2024:08:07,EPSG,
HC,1,3,0,CRS Number/EPSG Code/Name/Source                ,4,   ,                        Bin Grid,11.015,2024:08:07,EPSG,
HC,1,4,0,CRS Number/EPSG Code/Type/Name                  ,1,2193,1,projected 2D,NZGD2000 / New Zealand Transverse Mercator 2000
HC,1,4,3,Base CRS Details                                ,1,2,4167,NZGD2000
HC,1,5,0,Projection                                      ,1,19971,New Zealand Transverse Mercator 2000
HC,1,5,1,Projection Method                               ,1,9807,Transverse Mercator,5
HC,1,5,2,Latitude of natural origin                      ,1,8801,      0,3,degree
HC,1,5,2,Longitude of natural origin                     ,1,8802,    173,3,degree
HC,1,5,2,Scale factor at natural origin                  ,1,8805,  0.9996,4, unity
HC,1,5,2,False easting                                   ,1,8806, 1600000,1, metre
HC,1,5,2,False northing                                  ,1,8807,10000000,1, metre
HC,1,6,0,Coordinate System                               ,1,4500,Cartesian 2D CS. Axes\u003A northing\u002C easting (N\u002CE). Orientations
HC,1,6,1,Coordinate System Axis 1                        ,1,1,,Northing,north,N,1,metre
HC,1,6,1,Coordinate System Axis 2                        ,1,2,, Easting, east,E,1,metre
HC,1,4,0,CRS Number/EPSG Code/Type/Name                  ,2,4167,2,geographic 2D,NZGD2000
HC,1,4,4,Geodetic Datum                                  ,2,6167,New Zealand Geodetic Datum 2000,,2007:11:16,0.00
HC,1,4,5,Prime Meridian                                  ,2,8901,Greenwich,0,3,degree
HC,1,4,6,Ellipsoid                                       ,2,7019,GRS 1980,6378137,1,metre,298.257222101
HC,1,6,0,Coordinate System                               ,2,6422,Ellipsoidal 2D CS. Axes\u003A latitude\u002C longitude. Orientations
HC,1,6,1,Coordinate System Axis 1                        ,2,1,, Geodetic latitude,north,Lat,3,degree
HC,1,6,1,Coordinate System Axis 2                        ,2,2,,Geodetic longitude, east,Lon,3,degree
HC,1,4,0,CRS Number/EPSG Code/Type/Name                  ,3,4326,2,geographic 2D,WGS 84
HC,1,4,4,Geodetic Datum                                  ,3,1383,World Geodetic System 1984 (G2296),,2024:01:02,2024.00
HC,1,4,5,Prime Meridian                                  ,3,8901,Greenwich,0,3,degree
HC,1,4,6,Ellipsoid                                       ,3,7030,WGS 84,6378137,1,metre,298.257223563
HC,1,6,0,Coordinate System                               ,3,6422,Ellipsoidal 2D CS. Axes\u003A latitude\u002C longitude. Orientations
HC,1,6,1,Coordinate System Axis 1                        ,3,1,, Geodetic latitude,north,Lat,3,degree
HC,1,6,1,Coordinate System Axis 2                        ,3,2,,Geodetic longitude, east,Lon,3,degree
```

Geodetic Integrity - Why

Geographical Coordinates
Latitude, Longitude relative to a defined geographical CRS
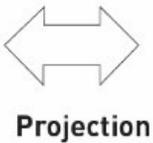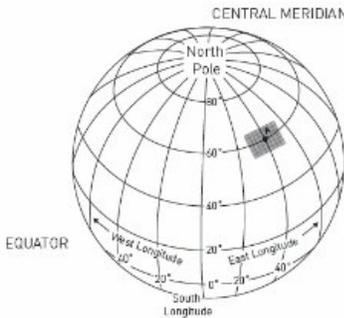
Projected Coordinates
Easting and Northing - relative to a defined geographical CRS and projection
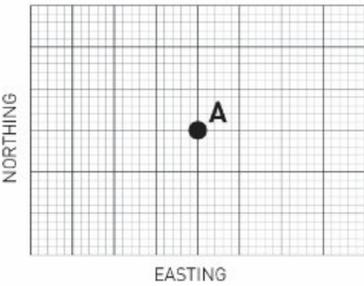
Seismic Bin Grid Georeferenced to Projected CRS
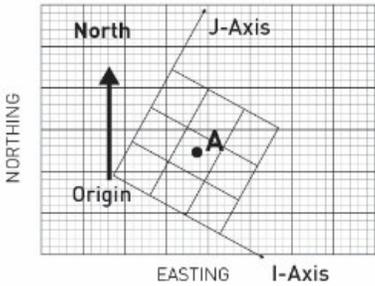
Bin Coordinates
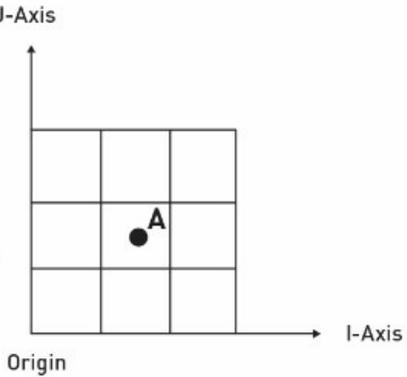
Geodetic Integrity - Why

- Although the EPSG Geodetic Dataset is comprehensive, not all geodetic systems are covered

- Companies maintain company-specific Geodetic Databases based on – and extended from - EPSG

https://epsg.org

Geoscience Applications

Company Geodetic Repository

EPSG Dataset

User CRS Definition

QC Processes
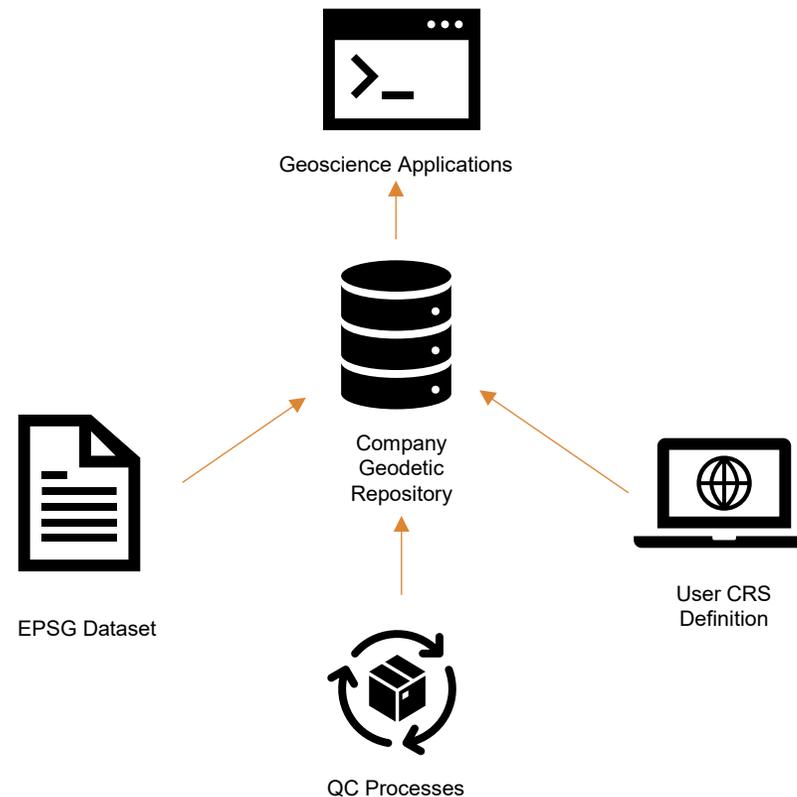
Geodetic Integrity - Why

- Thus, transferring data from Company A to Company B has the potential for loss of reference

- The same is true when loading data into a software package or data platform

ED50/TM 121NE

????

Company A

Company B

Geodetic Integrity - Why

- When a bin grid is defined, this is extremely unlikely to be available in the second company geodetic database.

- Px/11 contains a mathematical definition of the bin grid, not just 4 corner points.

Bin Grid

????

Company A

Company B

Geodetic Integrity

- Px/11 is designed to be verifiable – a number of check values are included to ensure software reading the files can validate that the parameters have been correctly written into the format

```
HC,1,9,0,Example Point Conversion, 1, Test Point 1,1,5665723.0000,1702835.0000,,2,-39.151623552,174.190110902
HC,1,9,0,Example Point Conversion, 2, Test Point 2,1,5667355.0000,1703347.0000,,2,-39.136859940,174.195786260
HC,1,9,0,Example Point Conversion, 3, Test Point 3,1,5668401.0000,1704257.0000,,2,-39.127327881,174.206152546
HC,1,9,0,Example Point Conversion, 4, Test Point 4,1,5668458.0000,1705358.0000,,2,-39.126681878,174.218878521
HC,1,9,0,Example Point Conversion, 5, Test Point 5,1,5668439.0000,1706496.0000,,2,-39.126714655,174.232044110
HC,1,9,0,Example Point Conversion, 6, Test Point 6,1,5667449.0000,1707229.0000,,2,-39.135543672,174.240678788
HC,1,9,0,Example Point Conversion, 7, Test Point 7,1,5665745.0000,1706468.0000,,2,-39.150988470,174.232143280
HC,1,9,0,Example Point Conversion, 8, Test Point 8,1,5664473.0000,1706560.0000,,2,-39.162436685,174.233407844
HC,1,9,0,Example Point Conversion, 9, Test Point 9,1,5663810.0000,1706995.0000,,2,-39.168356252,174.238546536
```

Geodetic Integrity

- Geodetic Computations are complex and multiple algorithms exist

```
HC,1,9,0,Example Point Conversion, 1, Test Point 1,1,5665723.0000,1702835.0000,,2,-39.151623552,174.190110902
HC,1,9,0,Example Point Conversion, 2, Test Point 2,1,5667355.0000,1703347.0000,,2,-39.136859940,174.195786260
HC,1,9,0,Example Point Conversion, 3, Test Point 3,1,5668401.0000,1704257.0000,,2,-39.127327881,174.206152546
HC,1,9,0,Example Point Conversion, 4, Test Point 4,1,5668458.0000,1705358.0000,,2,-39.126681878,174.218878521
HC,1,9,0,Example Point Conversion, 5, Test Point 5,1,5668439.0000,1706496.0000,,2,-39.126714655,174.232044110
HC,1,9,0,Example Point Conversion, 6, Test Point 6,1,5667449.0000,1707229.0000,,2,-39.135543672,174.240678788
HC,1,9,0,Example Point Conversion, 7, Test Point 7,1,5665745.0000,1706468.0000,,2,-39.150988470,174.232143280
HC,1,9,0,Example Point Conversion, 8, Test Point 8,1,5664473.0000,1706560.0000,,2,-39.162436685,174.233407844
HC,1,9,0,Example Point Conversion, 9, Test Point 9,1,5663810.0000,1706995.0000,,2,-39.168356252,174.238546536
```

- GIGS testing helps but allowing applications to check data load themselves is a good additional check

51° 45' 45.123" N
6° 35' 15.124" W

545666.6E
6023404.5N

545666.2E
6023406.5N

GIGS https://gigs.iogp.org

International Association of Oil & Gas Producers
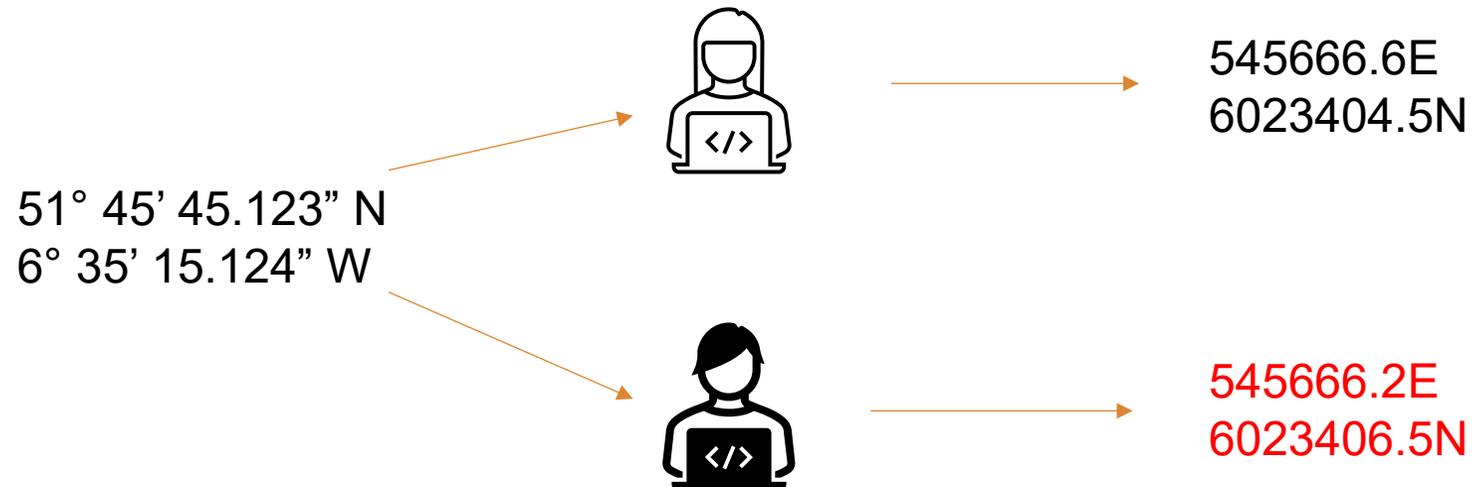
P6/11 during the Seismic Data Lifecycle

- Planning

- Data Acquisition

- Data Processing

- Loading and Interpretation

- Merging and Reprocessing

- Archival and Storage, including any later cycles of further data re-processing, loading, interpretation and merging

- Having a P6/11 during the later stages of the lifecycle ties the data back to the original acquisition.

International Association of Oil & Gas Producers

Px/11 and SEG-Y together

- Px/11 stores vital information which isn't present in the SEG-Y headers, so providing it with the SEG-Y will aid automation

- Moving Data between different systems and different data silos highlights the need for the data integrity Px/11 provides

- As having two files is never ideal, the Px/11 should be embedded into the SEG-Y using the Extended Textual Header (ETH) functionality.

Seg-Y Version 2.1: Embedding Data with Extended Textual Headers

Extended Textual Headers

Textual File Header
3200 bytes

↓

Binary Header
400 bytes

↓

Trace Header(s)
240 bytes

↓

Trace Data
Variable bytes

Repeated for each trace

SEG-Y Rev 0

International Association of Oil & Gas Producers

Extended Textual Headers

Textual File Header

3200 bytes

Binary Header

400 bytes

Trace Header(s)

240 bytes

Trace Data

Variable bytes

Repeated for each trace

Textual File Header

3200 bytes

Binary Header

400 bytes

Extended Textual Headers

3200 bytes

Repeated as required

Trace Header(s)

240 bytes

Trace Data

Variable bytes

Repeated for each trace

SEG-Y Rev 1 onwards

Extended Textual Headers

- "SEG-Y_r2.1: Extended Textual Header Clarification"

- The SEG Technical Standard Committee recently published a clarification document detailing how Extended Textual Headers can be used to embed documents.

- Each block of ETHs that make up a document are started with a Stanza Name so that decoding software can identify the presence of the ETHs.

- The last ETH block is a blank "SEG:EndText" block

((SEG:Layout:text/xml))

<?xml version="1.0" encoding="utf-8"?>

<segy-layout name="rev2">…

<entry name="initgain" byte="123" type="int2"/>

…

<entry name="corrflag" byte="125" type="int2"/>

…</segy-layout>

SPACE Characters to pad to 3200 bytes
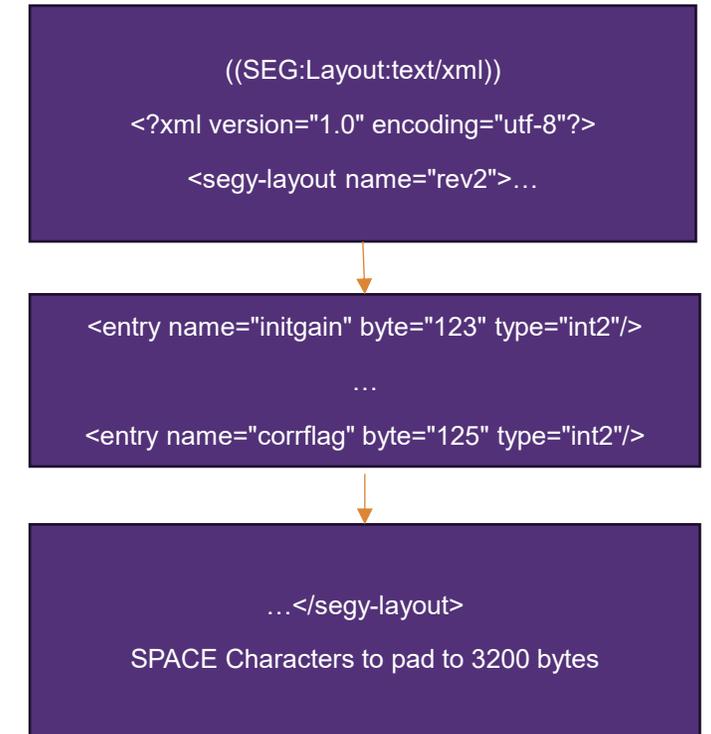
Extended Textual Headers

- The Stanza Name identifies the Extended Textual Header and can also detail the type and size if required
    - SEG:LAYOUT:text/xml
    - SEG:Catalog:application/json
    - OGP:P6/11:text/csv
    - TROIKA:IMAGEPNG:image/png:51929

For more information, see "SEG-Y_r2.1: Extended Textual Header Clarification" - SEG Technical Standards Committee 1 May 2025

Example Showing ETHs containing P-Format and other information.

Example SEG-Y File

- An example of a SEG-Y rev 2.1 file can be found at

  https://storage.3.basecamp.com/3710339/blobs/727f6a62-679c-11f0-aa21-0242ac120005/download/BO_3D-Inglewood_rev21_v7.sgy.gz?attachment=true

- This file embeds 5 files of differing types, including the Trace XML and P6/11

- Other examples are being developed and will be made available soon

Example SEG-Y File

- XML Trace Header Layout

Example SEG-Y File

- The example file also contains P6/11 and P1/11 headers.

Example SEG-Y File

- JSON. This example shows how JSON can be leveraged as an additional ETH to capture additional data as required.

- It is envisaged that companies will develop their own cover documents that define metadata requirements in SEG-Y extended textual headers, whether pre-defined or proprietary.

Example SEG-Y File

- Binary Data, in this case a PNG image file, to show how binary documents are handled.

How Embedding Structured Data will aid automation
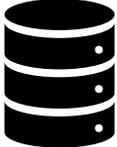
Manual Loading

SEG-Y File

Header Displayed

User Interprets Header
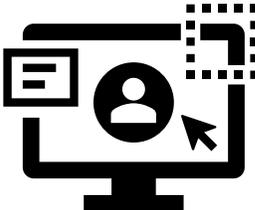
Values Defined

Data Silo – e.g. OSDU

Automatic Loading

SEG-Y File

Software Processes and
Verifies Data

Data Silo –
e.g. OSDU

Conclusions and Recommendations

Conclusions and Recommendations

- Reservoir seismic surveys cost millions of dollars to acquire and great care is applied to reliably position the processed traces.

- That reliability can easily be compromised if positioning data is subsequently corrupted through incomplete or incorrect metadata in data transfer, management or loading processes

- Moving to SEG-Y v2.1 with an embedded XML trace definition aids automation

- A SEG-Y file doesn't contain the information to ensure the positioning data is transferred in an automated and standard format. The use of a P-Format file embedded into the Extended Textual Headers available in SEG-Y Rev 2.1 ensures this metadata remains available when the SEG-Y data is exchanged.

International
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of Oil & Gas
Producers

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