Applied Analytics for Digital Enterprises

greenojo
smart n sustainable solutions

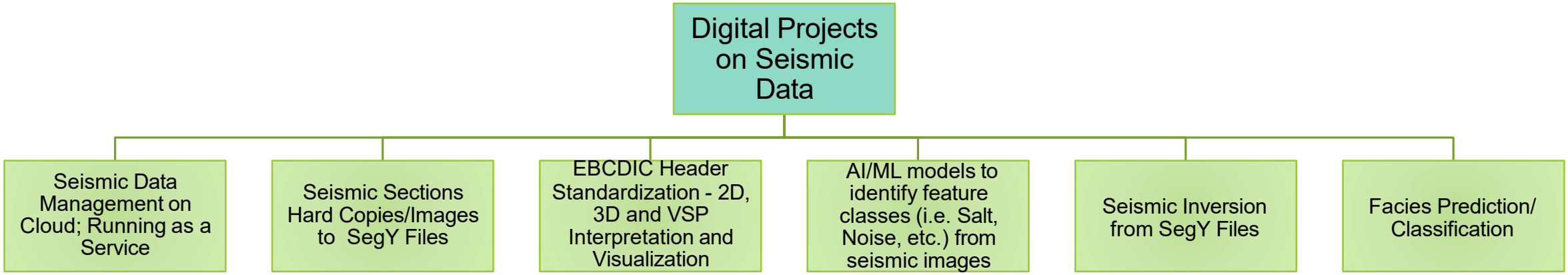
Seismic Data Management

Applying Cloud, Automation, AI/ML and Deep Learning

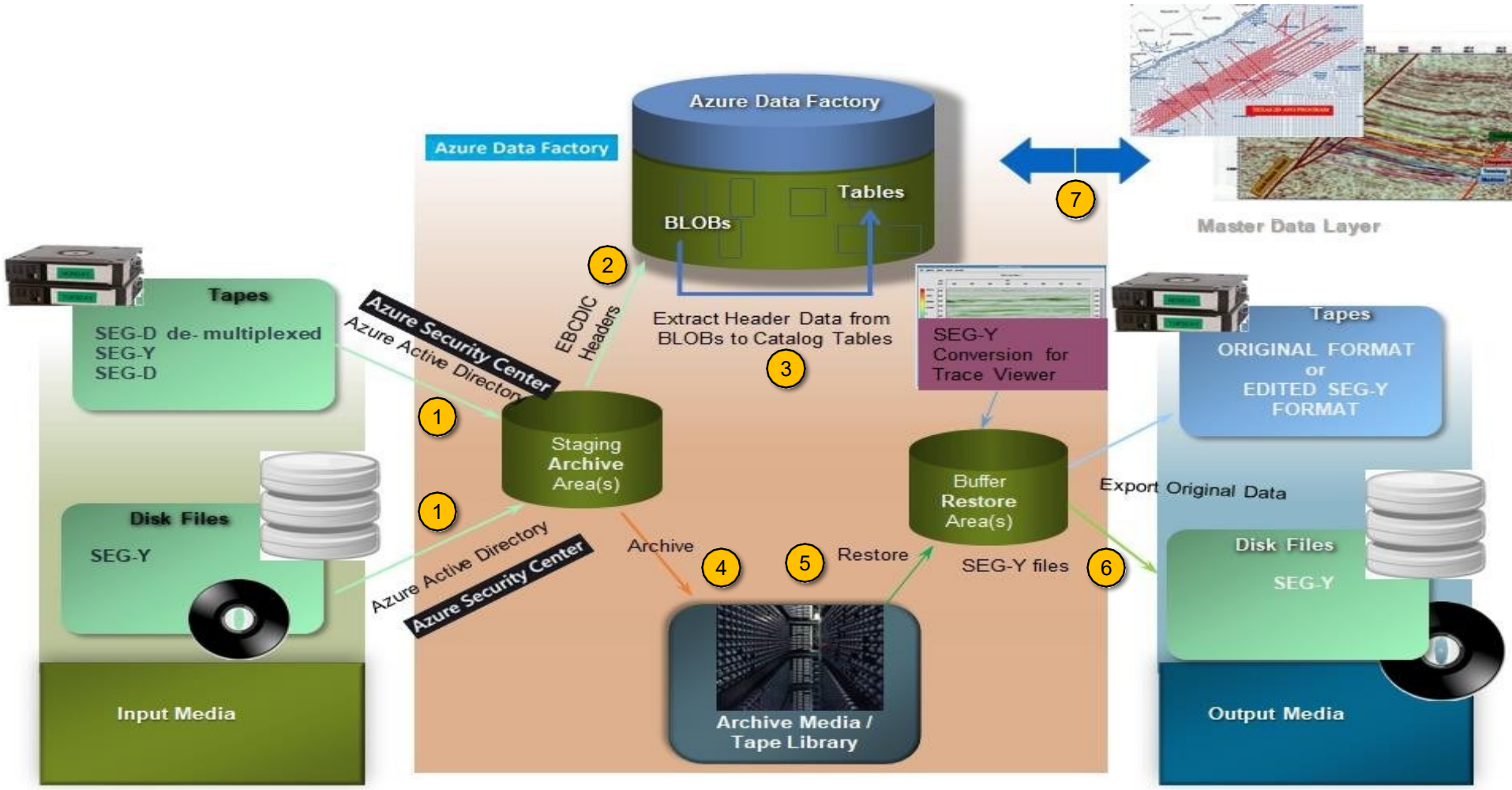
Seismic Data Solutions

01	Seismic Data Management on Cloud
02	Seismic Sections Hard Copy/Images to SegY Files
03	EBCDIC Header Standardization (2D, 3D & VSP)
04	AI/ML models to identify feature classes
05	Seismic Inversion
06	Facies Prediction/ Classification

Digital Projects on Seismic Data



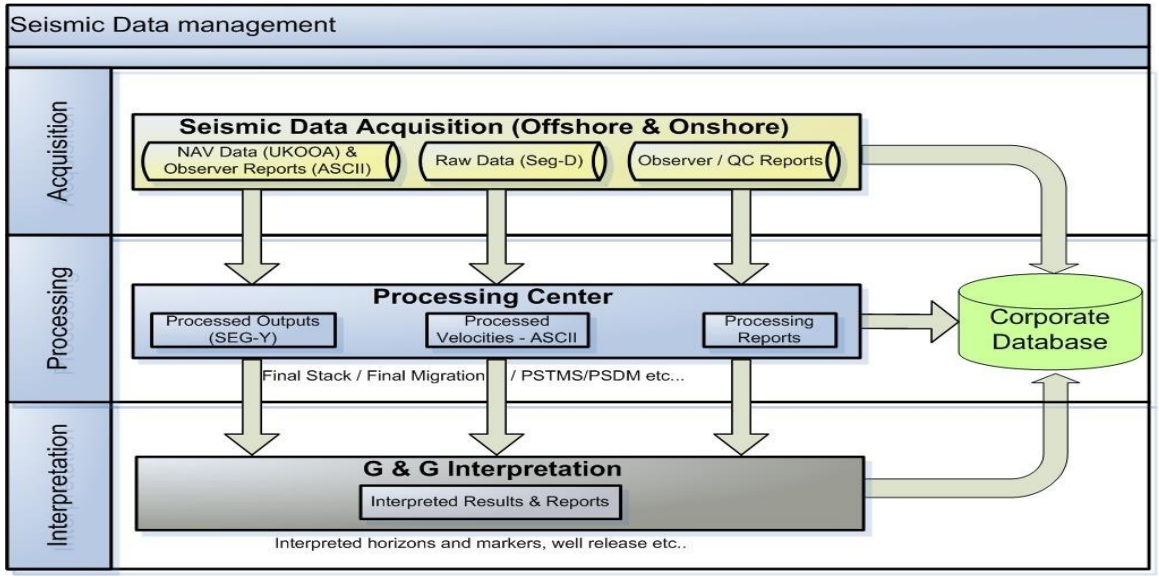
Applied Cloud
Seismic Data Management on Azure Cloud

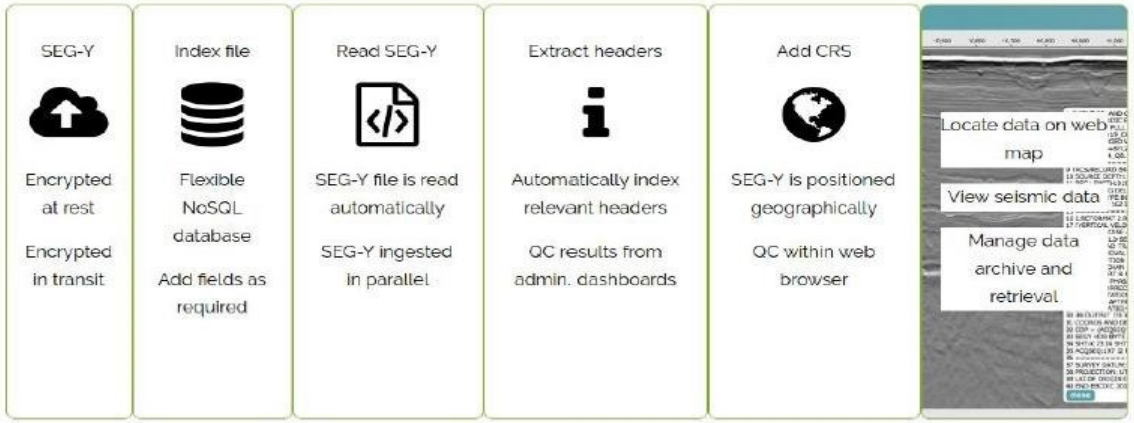


1 — 7

We have built automated scripts

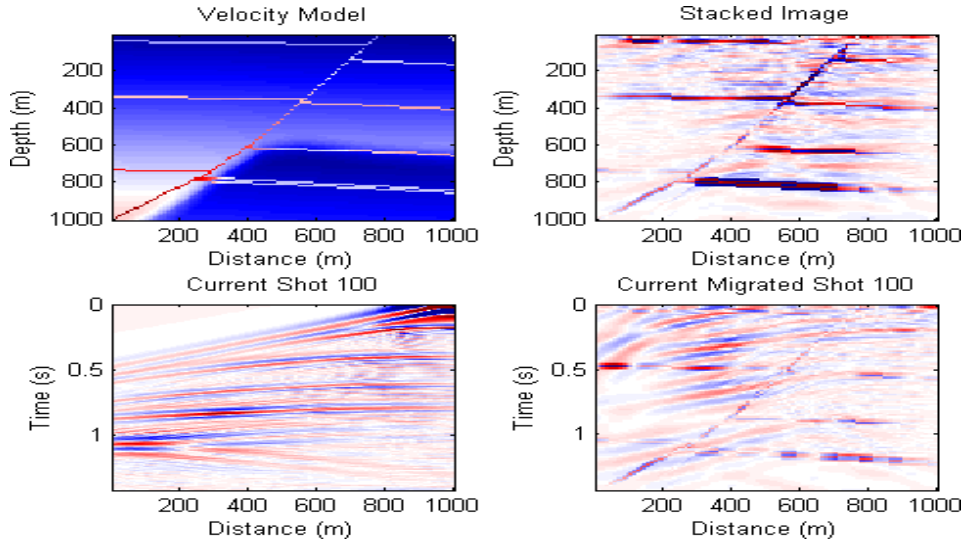
Applied Cloud
Leveraging Cloud for Seismic Projects as a Service





In a private/public cloud platform, we can set up integrated seismic data management and analytics services for your clients -

- Open Source/3rd Party Seismic Interpretation Stack running as a service
- Extensible Stack via Plug-Ins
- Enable your geophysicists to be mobile
- Ready interfaces with AI/ML,HPC tools
- Running Process Shots such as Reverse Time Migration, Kirchhoff Migration, etc.



Applied Automation
EBCDIC Header Standardization

A typical seismic EBCDIC header, before validating and Updating

```
C01  PETRASEIS HEADER
C02  GENERATED BY PETRASEIS
C03  BY GEOPLUS CORPORATION
C04  LINE NAME:  LINE-2
C05  START SHOT: 5.000  END SHOT: 150.500
C06  START CDP: 10  END CDP: 301
C32896  SHOT BYTES 17-20   CDP BYTES 21-24
C08  SAMPLE RATE: 2.000000  SAMPLES: 1501
C 9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21 to C39
C40
```

EBCDIC Header Standardization:2D data

```
C 1 CLIENT: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX   2D SEISMIC DATA
C 2 LINE:XXXX-01            SURVEY:XXXXXXXXXXXXXXXXXXXXX AREA:XXXXXXXXXXXXXXXXXXX
C 3 SPHEROID:EVEREST75      PROJECTION:UTM-44             CM : XX      CP2: XX
C 4 FSP:     74       IS AT  LAT: dd mm ss.ss N           LON: dd mm ss.ss E
C 5 LSP:   1088       IS AT  LAT: dd mm ss.ss N           LON: dd mm ss.ss E
C 6 FCDP:      1      SP ON FCDP:      1        LCDP:  1088     SP ON LCDP:  1088
C 7 ADDITIONAL SP CDP RELATION PAIRS FOR CROOKED PROFILE (OTHERWISE BLANK)
C 8 ADDITIONAL SP CDP RELATION PAIRS FOR CROOKED PROFILE (OTHERWISE BLANK)
C 9 BLANK
C10 ACQUISITION PARAMETERS
C11 RECORDING YEAR: 2004   AGENCY:XXXX                   VESSEL/PARTY:XXXXX
C12 SYSTEM:DFS-IV          REC FORMAT:SEG-B              LOW/HIGHCUT:  8/128 HZ
C13 NO OF CHANNELS: 96     FOLD:  48                     SOURCE: VIBROSEIS
C14 SAMPLE INTERVAL: 2MS   REC LENGTH: 5000 MS          REC START TIME:  0MS
C15 SHOT INTERVAL: 100 M   GROUP INTERVAL: 100 M        NEAR OFFSET: 200 M
C16 LAYOUT:SPLITSPREAD     BACK CHANNELS:  72            FORWARD CHANNELS: 24
C17 ENTER ADDITIONAL INFORMATION HERE
C18 ENTER ADDITIONAL INFORMATION HERE
C19 BLANK
C20 PROCESSING PARAMETERS  AGENCY: XXX, LOCATION, ORGNISATION  BASIC/REPROCESSING
C21 PROCESSING STEPS
C22 PROCESSING STEPS
C23 PROCESSING STEPS
C24 PROCESSING STEPS
C25 PROCESSING STEPS to C35 PROCESSING STEPS
C36 BLANK
C37 PROCESSED OUTPUT STORED IN THIS TAPE:DMOSTK/MISTK/PSTM/PSDM
C38 DOMAIN:TIME/DEPTH      REC LENGTH: 4000 MS        SAMPLE INTERVAL: 4 MS
C39 BLANK
C40 END EBCDIC
```

Applied Automation
EBCDIC Header Standardization

EBCDIC Header Standardization:3D data

```
C 1 CLIENT: XXXXXXXX.                                    3D SURVEY
C 2 AREA:BLOCK XXXX        SURVEY:XXXXXXXXXX             PROSPECT:XX-X
C 3 SPHEROID:WGS-XX        PROJECTION:UTM-XX             CM : XX      CP2: XX
C 4 FIRST LIVE             INLINE:     1                 X-LINE:     1
C 5 LAST  LIVE             INLINE:  2000                 X-LINE:  2000
C 6 PROSPECT CORNERS:
C 7 A:DDDMMSS.S NDDDMMSS.S E B:DDDMMSS.S NDDDMMSS.S E C:DDDMMSS.S NDDDMMSS.S E
C 8 D:DDDMMSS.S NDDDMMSS.S E E:DDDMMSS.S NDDDMMSS.S E F:DDDMMSS.S NDDDMMSS.S E
C 9 G:DDDMMSS.S NDDDMMSS.S E H:DDDMMSS.S NDDDMMSS.S E I:DDDMMSS.S NDDDMMSS.S E
C10 ACQUISITION PARAMETERS
C11 RECORDING YEAR: 2004   AGENCY:XXXX                  VESSEL/PARTY:XXXXX
C12 SYSTEM:DFS-IV          REC FORMAT:SEG-B              LOW/HIGHCUT:  8/128 HZ
C13 NO OF CHANNELS: 96     FOLD:  48                     SOURCE: VIBROSEIS
C14 SAMPLE INTERVAL: 2MS   REC LENGTH: 5000 MS          REC START TIME:  0MS
C15 SHOT INTERVAL: 100 M   GROUP INTERVAL: 100 M        NEAR OFFSET: 200 M
C16 LAYOUT:SPLITSPREAD     BACK CHANNELS:  72            FORWARD CHANNELS: 24
C17 ENTER ADDITIONAL INFORMATION HERE
C18 ENTER ADDITIONAL INFORMATION HERE
C19 BLANK
C20 PROCESSING PARAMETERS  AGENCY:AGS GEOPHYSICAL      BASIC/REPROCESS
C21 PROCESSING GRID:       AZIMUTH: 90.5 DEG           BIN SIZE: 12.5 x 25.0 M
C22 G1   X: 0000000.0      Y: 0000000.0      INLINE:     1       XLINE:     1
C23 G2   X: 0000000.0      Y: 0000000.0      INLINE:     1       XLINE:  2000
C24 G3   X: 0000000.0      Y: 0000000.0      INLINE:  2000       XLINE:     1
C25 to C36 PROCESSING STEPS
C37 PROCESSED OUTPUT STORED IN THIS TAPE:DMOSTK/MISTK/PSTM/PSDM
C38 DOMAIN:TIME/DEPTH      REC LENGTH: 4000 MS           SAMPLE INTERVAL: 4 MS
C39 BLANK
C40 END EBCDIC
```

EBCDIC Header Standardization of VSP data

```
C 1 CLIENT: XXXXXXXXXXXX                                 VSP DATA
C 2 UWI:xxxxxxxxx-1        FIELD:XXXXXXX                 AREA:Xxxxxxxx
C 3 SPHEROID:WGS-XX        PROJECTION:UTM-XX             CM : XX      CP2:
C 4 WELL NAME:XX-X         LOC    LAT: 00 00 00.00 N     LON: 00 00 00.00 E
C 5 DATUM:MSL              KB:xx.xxM       GL00.00M
C 6 FCDP:   1              LCDP: 166       FSP:  1       LSP:  41
C 7 DEPTH LOGGED: xxxx.x TO xxxx.x M
C 8 CASING SIZE:
C 9
C10 ACQUISITION PARAMETERS
C11 RECORD DATE:MAR-1998   AGENCY:xxxxxxx
C12 SYSTEM:CSAT TRIAXIAL   REC FORMAT:DLIS               SOURCE:AIR GUN
C13 GUN DEPTH: 5.0 M       PRESSURE: 2000.0 PSI          AZIMUTH:  10.0 DEG
C14 SAMPLE INTERVAL: 1MS   REC LENGTH: 5000 MS           REC START TIME:   MS
C15 SHOT INTERVAL:     M   GROUP INTERVAL:     M         NEAR OFFSET:  0 M
C16 LAYOUT:ZERO OFFSET     BACK CHANNELS:                FORWARD CHANNELS:
C17 HYDROPHONE DEPTH: 8.0 M WELL GEOPHONE TYPE:SM-4
C18
C19
C20 PROCESSING PARAMETERS  AGENCY: xxxxxxx
C21 DEPTH LEVELS PROCESSED:
C22 UPGOING WAVE FIELD (MIN PHASE) AFTER WAVESHAPING DECON:1 - 41 TRACES
C23 UPGOING WAVE FIELD (ZERO PHASE) AFTER WAVESHAPING DECON:42 - 82 TRACES
C24 CORRIDOR STACK (MIN PHASE)(10-60HZ):83 - 94 TRACES
C25 CORRIDOR STACK (ZERO PHASE)(10-60HZ):95 - 106 TRACES
C26 GEOGRAM (MIN PHASE) 20 HZ RICKER:107 - 118 TRACES
C27 GEOGRAM (MIN PHASE) 30 HZ RICKER:119 - 130 TRACES
C28 GEOGRAM (MIN PHASE) 40 HZ RICKER:131 - 142 TRACES
C29 GEOGRAM (MIN PHASE) 35 HZ RICKER:143 - 154 TRACES
C30 GEOGRAM (ZERO PHASE) 35 HZ RICKER:155 - 166 TRACES
C31 to C35 Additional Information
C36 PROCESSED OUTPUT STORED IN THIS TAPE:VSP SEGY DATA
C37 DOMAIN:TIME            REC LENGTH: 5000 MS           SAMPLE INTERVAL: 1 MS
C38
C39

C40 END EBCDIC
```

Applied Automation
Seismic Sections Images to SegY

Get the Seismic Sections Images (.tiff/.jpg)– Repository API/ FTP Loads

↓

Image Registration and Loading in our Scripts

↓

Header Extraction and Data Cleansing (e.g. Timeline removal), followed by enhancements

↓

Generate SegY and Analyze the File

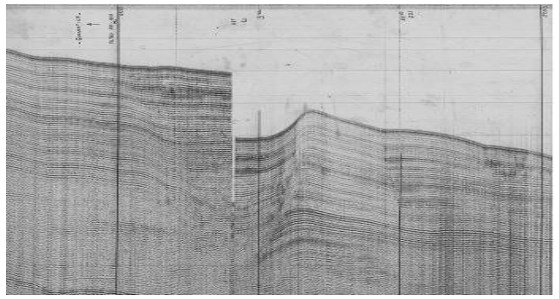
↓

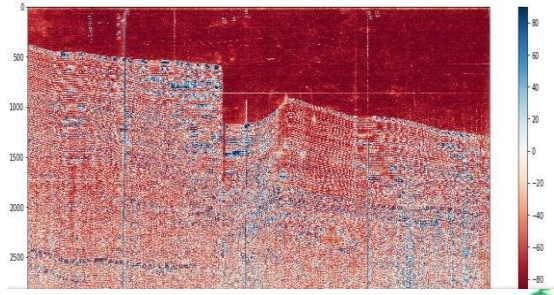
Quality Control/QC (Auto + Manual)

↓

SegY – EBCDIC header standardization

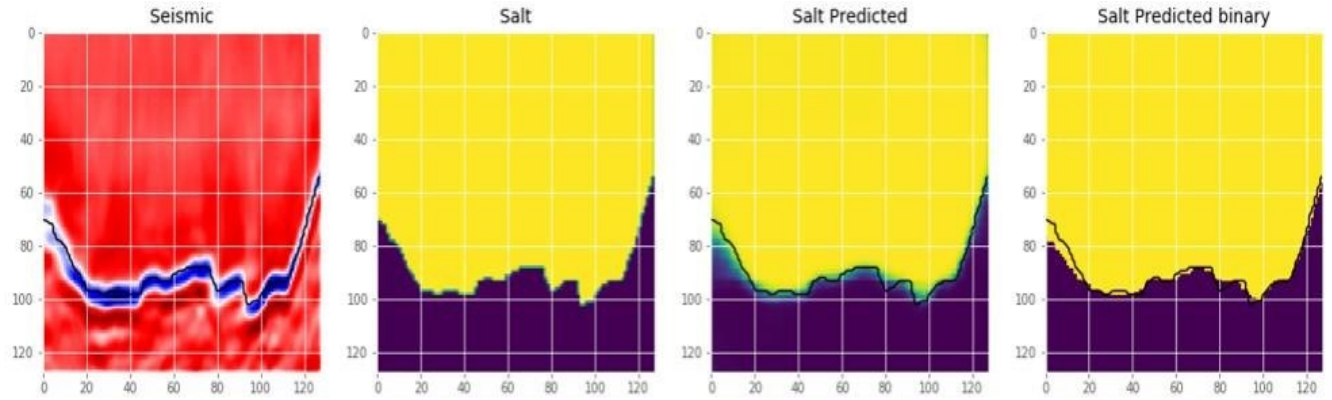
- Typical TAT for each image file will be ~1 hr/image
  - Automated Scripts with QC (Auto+Manual) to take 0.5 hr for each image conversion process
  - Analytical Reports as well as SegY enhancements, to take additional 0.5 hr for each generated SegY file
- Solution can be consumed as a Service running on MS Azure



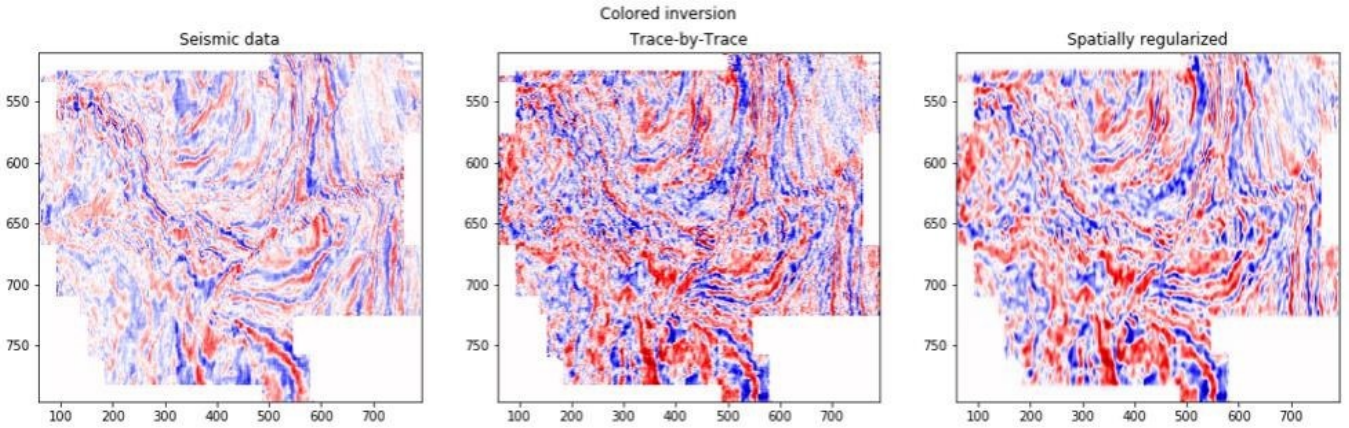


Applied AI/ML
Salt Prediction, Seismic Inversion

- **Salt Prediction** - One of the challenges of seismic imaging is to identify the part of subsurface which is salt. Salt density is usually 2.14 g/cc which is lower than most surrounding rocks. The seismic velocity of salt is 4.5 km/sec, which is usually faster than its surrounding rocks. This difference creates a sharp reflection at the salt-sediment interface. *The unusually high seismic velocity of salt can create problems with seismic imaging.*



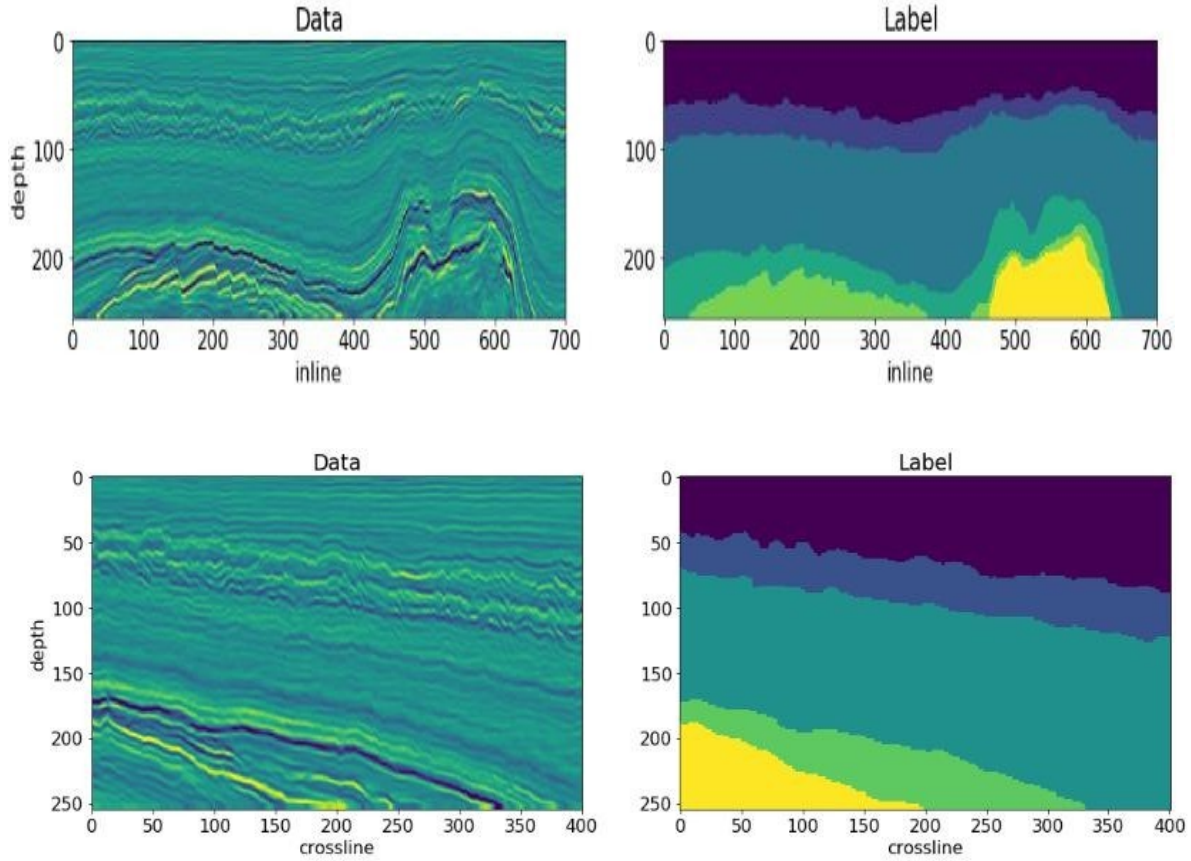
- **Seismic Inversion** - Transforming seismic reflection data into a quantitative rock-property description of a reservoir. Seismic data may be inspected and interpreted on its own without inversion, but this does not provide the most detailed view of the subsurface and can be misleading under certain conditions. *Because of its efficiency and quality, most oil and gas companies now use seismic inversion to increase the resolution and reliability of the data and to improve estimation of rock properties.*



Applied Deep Learning
Facies Prediction

Leveraging a deep neural network for facies prediction

- Seismic interpretation, also referred to as facies classification, is a task of determining types of rock in the earth's subsurface, given seismic data.
- Seismic interpretation is used as a standard approach for determining precise locations of oil deposits for drilling, therefore reducing risks and potential losses.



Thank You

Greenojo provides Automation, Analytics and AI solutions to enterprise customers

For RFPs, Solutions and Sales/Partner enquiries, connect us at - sales@greenojo.com