**Proposed changes to SEG-Y Rev 1.0 to create Rev 1.1** pch-16Apr13

**BINARY HEADER MODIFICATION**

bytes 3217-3218: Sample interval in microseconds (us or the units specified in Binary File Header bytes 3269-3270). Mandatory for all data types.

bytes 3219-3220: Sample interval in microseconds (us or the units specified in Binary File Header bytes 3269-3270) of original field recording.

bytes 3225-3226: Data formats.

 6 = 8-byte, IEEE floating point (as suggested for Rev 2)

 7 = 8-byte, IEEE complex

 8 = 1-byte, two’s complement integer (as in Rev 1)

 9 = 3-byte, two’s complement integer (as suggested for Rev 2)

 10 = 1-byte unsigned integer (used by GPR)

 11 = 2-byte unsigned integer (used by GPR)

 12 = 4-byte unsigned integer (used by GPR)

Bytes 3233-3234: Sweep frequency at start (Hz or the units specified in Binary Header File bytes 3271-3272)

Bytes 3235-3236: Sweep frequency at end (Hz or the units specified in Binary Header File bytes 3271-3272).

**BINARY HEADER ADDITIONS:**

Scalars are applied to trace header integers to give real values. The scalar may be positive or negative such as 1, 2, 10, 50, 100, 1000, 10000, 32767. If positive, scalar is used as a multiplier; if negative, scalar is used as a divisor. Zero is the same as one.

Binary Header scalars applied to Trace Header integers for conversion to real:

Bytes 3261-3262: Scalar for trace header bytes 115-116 (Number of samples in the trace).

Bytes 3263-3264: Scalar for trace header bytes 165-166 (Second of minute)

New timing identification codes are needed because 16 bit integer scalars are inadequate.

Bytes 3265-3266: General timing identification code to be applied to Trace Header bytes 91-94(weathering and subweathering velocities) and 131-132 (sweep length):

 0 or 1 = seconds

 2 = milliseconds (10-3s)

3 = microsecond (10-6s)

 4 = nanosecond (10-9 s; GPR)

5 = picosecond (10-12 s; GPR)

Bytes 3267-3268: Trace timing identification code to be applied to Trace Header bytes 95-114 (weathering, uphole, lag time, delay) and bytes 131-132 (sweep length):

0 or 1 = millisecond (10-3 s; seismic)

4 = nanosecond (10-9 s; GPR)

5 = picosecond (10-12 s; GPR)

Bytes 3269-3270: Sample interval time identification code to be applied to Binary File Header bytes 3217-3220 and Trace Header bytes 117-118:

0 or 1 = microsecond (10-6 s; seismic)

4 = nanosecond (10-9 s; GPR)

5 = picosecond (10-12 s; GPR)

Bytes 3271-3272: Frequency identification code (to be applied to relevant bytes (sweep start and end) in the Binary File Header and the Trace Header):

0 or 1 = Hz (seismic)

2 = KHz (103 Hz)

3 = MHz (106 Hz; GPR)

4 = GHz (109 Hz; GPR)

The byte numbering could change so as not to conflict with Levin’s Rev 2.0

**TRACE HEADER MODIFICATIONS**

Bytes 29-30: Trace identification code:

 28 = ASCII metadata

 100 = GPR data

 101 = GPR reflection

 102 = GPR transillumination

 103 = GPR CMP/WARR

 104 = autocorrelation

 105 = Fourier transformed - no packing, xr[0],xi[0], ..., xr[N-1],xi[N-1]

 106 = Fourier transformed - unpacked Nyquist, xr[0],xi[0],...,xr[N/2],xi[N/2]

 107 = Fourier transformed - packed Nyquist,

 Even N: xr[0], xr[N/2], xr[1], xi[1], ..., xr[N/2 -1], xi[N/2 -1] (note the exceptional second entry)

 Odd N: xr[0], xr[(N-1)/2], xr[1], xi[1], ..., xr[(N-1)/2 -1], xi[(N-1)/2 -1], xi[(N-1] (note the exceptional second & last entries)

 108 = Complex signal in the time domain, xr[0],xi[0], ..., xr[N-1],xi[N-1]

 109 = Fourier transformed - amplitude/phase, a[0],p[0], ..., a[N-1],p[N-1]

 110 = Complex time signal - amplitude/phase, a[0],p[0], ..., a[N-1],p[N-1]

 111 = Real part of complex trace from 0 to Nyquist

 112 = Imag part of complex trace from 0 to Nyquist

 113 = Amplitude of complex trace from 0 to Nyquist

 114 = Phase of complex trace from 0 to Nyquist

 115 = Wavenumber time domain (k-t)

 116 = Wavenumber frequency (k-omega)

 117 = Depth-Range (z-x) traces

 118 = Seismic data packed to bytes (by supack1)

 119 = Seismic data packed to 2 bytes (by supack2)

Bytes 37-40: Range or distance from center of source point to center of receiver group.

Extended the right hand part of the documentation for bytes 41-68 to cover this also.

“The scalar in Trace Header bytes 69-70 applies to these values. The units are feet or meters as specified ………”

Bytes 89-90: Coordinate Units.

 5 = Decimal degrees in 32 bit IEEE floating point.

Bytes 91-92: Weathering velocity (seismic) or upper layer velocity (GPR). (ft/s or m/s, or as specified in Binary File Header bytes 3255-3256 and 3265-3266)

Bytes 93-94: Subweathering velocity (seismic) or lower layer velocity (GPR). (ft/s or m/s, or as specified in Binary File Header bytes 3255-3256 and 3265-3266)

Bytes 95-114: Time in milliseconds or units specified in Binary Header File bytes 3267-3268 AND as scaled by the scalar in Trace Header bytes 215-216.

Bytes 115-116: Number of samples in this trace. Binary File Header scalar in bytes 3261-3262 may apply.

Bytes 117-118: Sample interval in microseconds or the units specified in Binary File Header bytes 3269-3270 .

Bytes 127-128: Sweep frequency at start in Hz or the units specified in Binary File Header bytes 3271-3272.

Bytes 129-130: Sweep frequency at end in Hz or the units specified in Binary File Header bytes 3271-3272.

Bytes 131-132: Sweep length in seconds, milliseconds, nanoseconds, or picoseconds (as specified in Binary File Header bytes 3265-3266).

Bytes 165-166: Second of Minute: unsigned short integer. Binary File Header scalar in bytes 3263-3264 may apply. E.G. When scalar is -1000 and value is 59999, the result is 59.999 seconds.

Bytes 215-216: Scalar to be applied to times specified in Trace Header bytes 95-114 to give the true time value in milliseconds, microseconds, nanoseconds, or picoseconds (as specified in Binary File Header bytes 3267-3268).

Bytes 217-218: Add source type/orientation codes to indicate GPR tow type/antenna orientations. Perpendicular means the long dimension of the antenna is perpendicular to the tow direction (one of the most common orientations). Broadside means the long dimension of the antennas are parallel. End-fire means the long dimension of the antennas are in-line.

 50 = Perpendicular broadside

 51 = Perpendicular endfire

 52 = Parallel broadside

 53 = Parallel endfire

 54 = Cross polarized

 56 = Monostatic perpendicular

 57 = Monostatic parallel

**Extended Textual File Header stanzas:**

Stanza for Location Data: Add "rectilinear" or "none" to enumerated list for keyword "CRS type." Because many, if not most, GPR surveys are relatively "small scale" (a few meters to a few hundred meters), projected coordinates and distances are fairly linear over the survey area and so a standard rectilinear system can often be adequate. Keywords "Coordinate system axis 1 name", "Coordinate system axis 2 name", and "Coordinate system axis 3 name", using values, e.g., "X", "Y", and "Z", respectively, would provide definitions. The survey grid would be defined in the "Stanza for Bin Grid Definition." For some surveys, it is simply not important exactly where on Earth the survey was performed. Granted this issue is, perhaps, a trivial point and could be ignored. But for software using rigorous adherence to the SEG Y rule requiring that a coordinated reference system "must be defined" in the Location Data Stanza, the suggested keywords would satisfy this requirement.

 **D-8. Real-Time Processing**

 **D-8.1 Stanza for Real-Time Processing**

The Real-Time Processing stanza provides a means to record the processing of a GPR data trace after it has been measured and before it is recorded to a medium.

**Table 14** Stanza for Real-Time Processing

 **Stanza and Keyword Format Comment**

((SEG: Real Time Processing ver 1.1))

The following entries are repeated as needed to define all real-time processing

operations to the raw data traces.

Operation Applied = Text 60 Name of algorithm being applied

 to the data traces

Number of Parameters = Integer

Param 1 Description = Text 60

Param 1 Value = Real Number

Param 2 Description = Text 60

Param 2 Value = Real Number

Param 3 Description = Text 60

Param 3 Value = Real Number

...

Param N Description = Text 60 Where N is the number of parameters

Param N Value = Real Number

 **D-8.2 Example stanza for Real-Time Processing**

((SEG: Real Time Processing ver 1.1))

Operation Applied = Trace stacking

Number of Parameters = 1

Param 1 Description = Number of traces stacked to get stored trace

Param 1 Value = 4

Operation Applied = Gain evenly distribute from 1st-last sample, linear between

Number of Parameters = 6

Param 1 Description = gain in dB at first sample

Param 1 Value = -2.5

Param 2 Description = gain in dB

Param 2 Value = 6

Param 3 Description = gain in dB

Param 3 Value = 19

Param 4 Description = gain in dB

Param 4 Value = 24.1

Param 5 Description = gain in dB

Param 5 Value = 35.6

Param 6 Description = gain in dB at last sample

Param 6 Value = 35.6

Operation Applied = Vertical FIR low pass

Number of Parameters = 1

Param 1 Description = Frequency cutoff, MHz

Param 1 Value = 750

Operation Applied = Vertical FIR high pass

Number of Parameters = 1

Param 1 Description = Frequency cutoff, MHz

Param 1 Value = 250