

## Appendix A: Processing and Display Steps:

Each of the panels in this compilation has been constructed from the archived SEGY files at Geoscience Australia, and the associated coordinates for the reflection lines.

The first step in the process was to convert all coordinates, for the individual CDP points, into latitude and longitude referred to the WGS 1984 datum, rather than grid references. In the process a few UTM zone assignments were corrected. By this means all lines can be handled in the same way.

The same coordinate files are used for the construction of the geological maps with line profiles and for the reflection sections. The data base for the geological maps and associated colour scheme were extracted from the 2010 release of the digital 1:1 million geological map of Australia, and the 1:2.5 million map for regional synthesis (Raymond, 2012). The handling of the shape files for both the reflection lines and the geological maps from the geographic information system was achieved using the open source software *ogr2ogr* [<http://www.gdal.org/>], linked to the plotting capabilities of Generic Mapping Tools (Wessel & Smith, 1998) to produce Postscript plots. All reflection profiles in a region were plotted onto geological information, so that the configuration of each reflection section relative to other data collection can be seen. The lines are annotated with CDP numbers at 1000 point intervals using the shape files. Some editing has been needed to improve the positioning of the computer-generated text.

The geological maps for the individual panels are plotted at the same scale. A transverse Mercator projection is used for each geological strip with appropriate reference meridian. The grid spacing employed is 0.5 degree in latitude and longitude. For the regional maps differing scales were employed so that they could be reasonably accommodated on a single page. These regional maps use varying Lambert conformal conical projections adapted to the region under consideration.

The archived digital SEGY files for each line, from Geoscience Australia reflection processing (stacked or migrated), were brought into the Seismic Un\*x environment (<http://www.cwp.mines.edu/cwpcodes/>) for modest processing. This was mostly a simple time scaling of amplitudes as described on page 2. The scaled files were then plotted using the python script *plot\_surveys\_with\_shapefile.py* detailed below, which invokes the *psseggy* facility from Generic Mapping Tools to produce a Postscript file for the record section.

The bias and clipping applied to the records are adjustable and are specified in the tables for the reflection profiles in each of the areas. These parameters control the appearance of the reflection plot – increased bias produces a lighter plot.

The python script arranges the segmentation of the reflection results into the 220 km segments used in the displays, with annotation of the approximate distance along the profiles derived from the coordinate information. As far as possible the displays of the reflection results are on the same horizontal scale. A constant time scale has been applied to each section with 20s of display plotted in each case, even if the recordings were of lesser or greater duration. The displays are approximately true scale, based on an average r.m.s. velocity of 6 km/s for the crust.

For each profile the reflection section was inserted into a Postscript template, with annotation of line information and acquisition parameters. More work was needed to extract suitable geological strip maps since these needed to follow the reflection line. A standard window was manipulated across a broad area geological plot until the reflection line of interest was suitably bracketed, and this material was added to the Postscript page. Coordinate annotation was then added to the geological strips so that the position of the line can be recognised, even though the orientation might not be standard NS or EW.

### References

- Raymond, O.L., 2012. Surface Geology of Australia (1:1M scale dataset) A3 map. Geoscience Australia, Canberra.
- Wessel, P. & Smith, W.H.F., 1998. New, improved version of the Generic Mapping Tools Released, *EOS Trans. AGU*, 79, 579.

*Python script: plot\_surveys\_with\_shapefile.py*

```
#This script reads all of the given files, then applies biasing (if selected),
#then computes consecutive cdp points and the distance,
#Then plots the section and a corresponding map.
import glob,string
import os,sys,numpy
from osgeo import ogr

import utils_plot_seggy
#sys.path.append('/home/kut/research/noise_python')
#import corr_utils,utilssac

#Give the name of the input text file, which contains the list of files to be processed
segylist='seggy_list_bySURVEY'
#Typical format would be like
#'/media/tr_3/GA_reflection/second_phase/L184/AL184/mig_07ga_ig1_20s.sgy'
#'/media/tr_3/GA_reflection/second_phase/L184/AL180/mig_07ga_ig1_20s.sgy'
#-----

#Open and read the contents
seggyfile=open(segylist,'r').readlines()
seggyfile=[seggyfile[i].strip() for i in range(len(seggyfile))]
#-----

#Give the name of the shape file, which contains the information of the full paths of the files, and
corresponding coordinate files
#shpfil='/media/local_300/research/australia_crustal_thickness/reflection_processing_scripts/matlab_ba
sed_picking/coordinates/test.shp'
shpfil='test.shp'
#-----

#Output directory for PS files
dirout='TEST_PLOTS'
os.system('mkdir '+dirout)
#-----

#Define the plotting parameters-FOR MORE INFORMATION CONSULT psseggy man pages (GMT
function).
#params='-D3 -F -N -B-1.4 -C95 -M' #ORIGINAL
params='-D3 -F -N -B-1.47 -C85 -M' #Migrated standard
#params='-D3 -Fred -N -B-1.4 -C95 -M' #This one will plot section in red.

cdps='all' #Cdps to choose #if it is all, everything will be plotted, if 5000:6000 is given, only these ones
will be plotted
#cdps='2001:15000' #Cdps to choose #if it is all, everything will be plotted, if 5000:6000 is given, only
these ones will be plotted
#cdps='11000:22000' #Cdps to choose #if it is all, everything will be plotted,
#if 5000:6000 is given, only these ones will be plotted

tmin=0 #Minimum time to plot
tmax=20 #Maximum time to plot
scal=0.1 #Scaling
```

```
#-----
#We need to define a max X length, according to this plotting should be divided.

#Define the KM tick marks.
kms=[]
kms.append(0)
#kms.append(50)
kms.append(100)
kms.append(200)
kms.append(300)
kms.append(400)
kms.append(500)
kms.append(600)

#-----

#Shape File Manipulation for getting the right info
driver = ogr.GetDriverByName('ESRI Shapefile')
map = driver.Open(shpfil)
#Get the first layer
layer = map.GetLayer(0)
nlay = map.GetLayerCount()
layer_list = [map.GetLayer(i) for i in xrange(nlay)]
layer_namelist = [map.GetLayer(i).GetName() for i in xrange(nlay)]

#print seggyfile
for i in range(len(seggyfile)):
#Select the file and corresponding attributes from the SHAPEFILE
srstr="select * from test where SEGY_Loc in ('"+seggyfile[i]+"")"
print srstr,i,' of ',len(seggyfile)
#Start searching the all attributes for the given file name
reslayer = map.ExecuteSQL(srstr)
numFeatures = reslayer.GetFeatureCount()
#-----
cdp=[]
lat=[]
lon=[]
#Print the results by moving along the feautres
for j in range(0,numFeatures):
reslayerfeat=reslayer.GetNextFeature()
geometry = reslayerfeat.GetGeometryRef()
cdp.append(float(reslayerfeat.GetField('CDP')))
lat.append(float(geometry.GetX()))
lon.append(float(geometry.GetY()))
reslayer.ResetReading() #Reset the layer.
#-----

#Sort the CDP and corresponding coordinates
indsrt=numpy.argsort(cdp) #Get the indices of the sorted CDP in ascending order
#Give the sorted CDPS, lats and lons to the plotting program, plotting will pick the right one
cdpsorted=[str(int(cdp[indsrt[ii]])) for ii in range(len(indsrt))]
```

```
latsorted=[lat[indsrt[ii]] for ii in range(len(indsrt))]  
lonsorted=[lon[indsrt[ii]] for ii in range(len(indsrt))]  
#-----  
splts=segfile[i].split('/')  
#Create the output file name  
plotout=dirout+'/' +splts[-1].replace('.sgy','')+"_"+splts[-2]+".ps"  
print plotout  
seg_len=220.0 #Segment Length  
#Plot Chosen Files
```

```
utils_plot_seggy.plot_seggy_plain_segments(segfile[i],params,plotout,cdpsorted,latsorted,lonsorted,cdps  
,tmin,tmax,scal,kms,seg_len)  
#-----  
  
#Destroy the opened Shape objects  
map.Destroy()  
reslayerfeat.Destroy()
```

This text is taken from *Deep Crustal Seismic Reflection Profiling: Australia 1978–2015*,  
edited by B.L.N. Kennett, E. Saygin, T. Fomin and R. Blewett, published 2016 by  
ANU Press and Commonwealth of Australia (Geoscience Australia), Canberra, Australia.