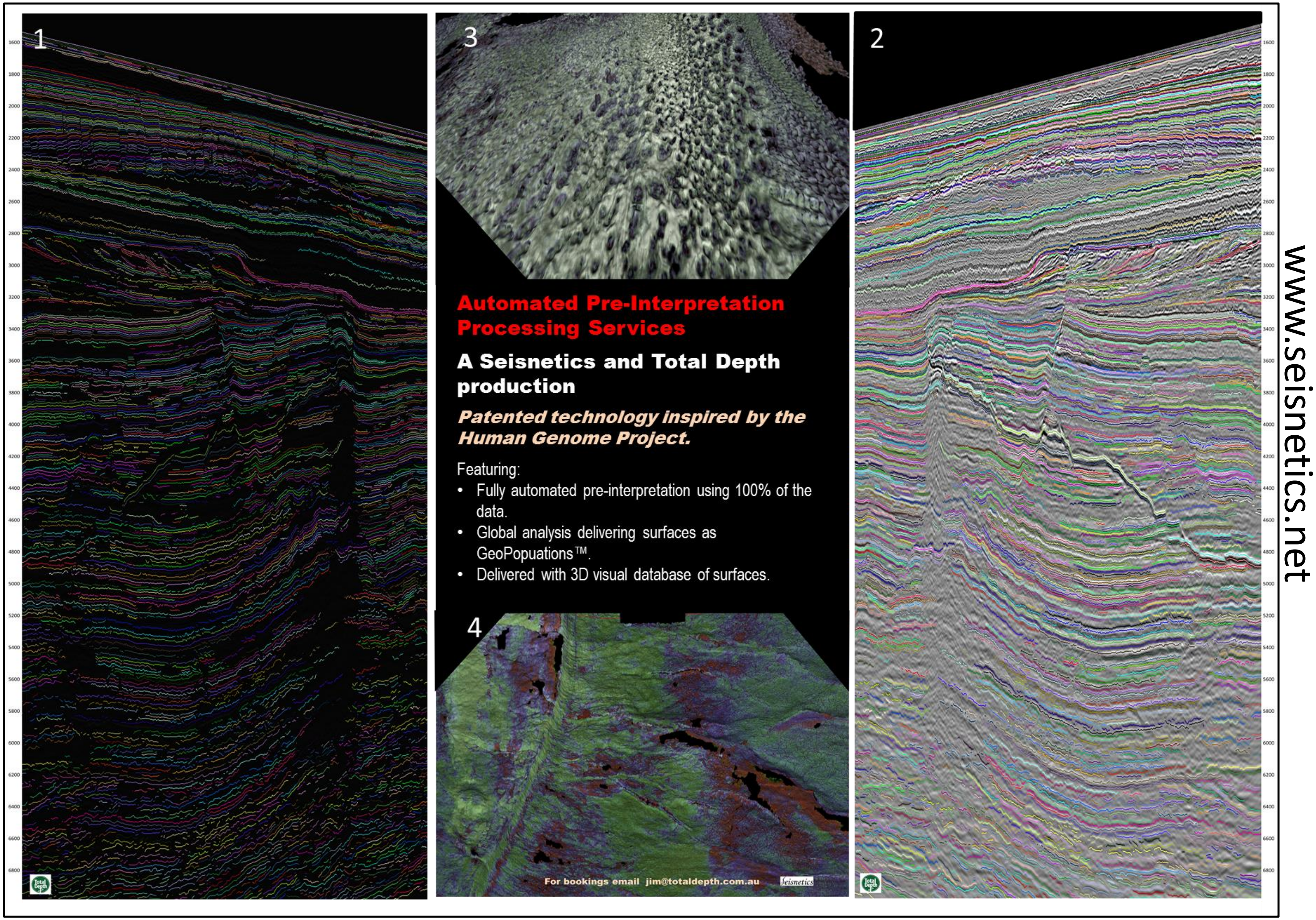
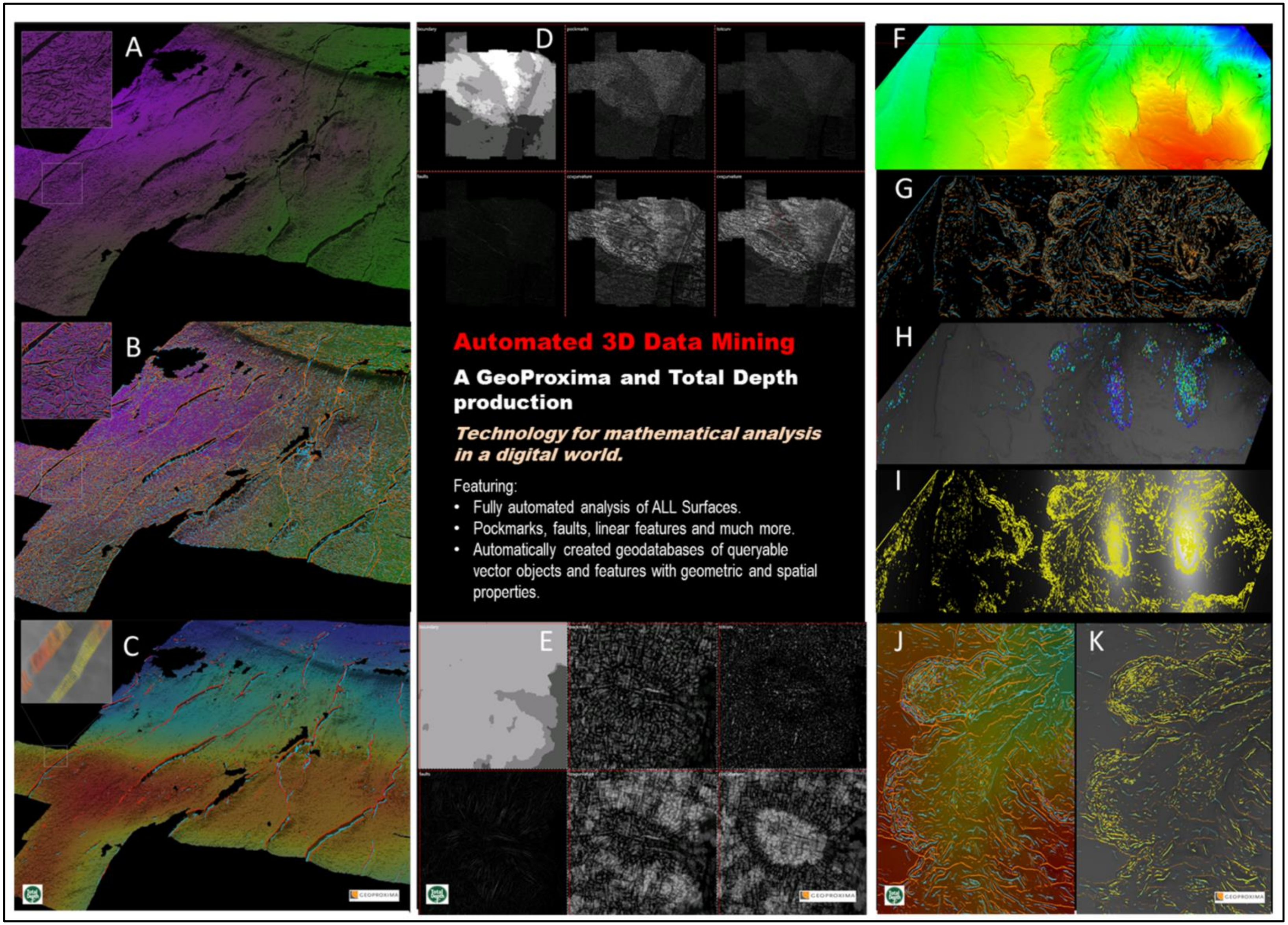


The post-stack application of the Seisnetics fully automated genetic segmentation algorithm, creates a 3D visual database of virtually all peak and trough populations from the processed volume. The patented algorithm, inspired by the Human Genome Project (**chromosome ≈ seismic trace; gene ≈ waveform**) targets the entire volume(s) and simultaneously evolves populations of genetically similar waveforms. For every population there is a TWT, amplitude and fitness attribute. The fitness attribute provides an indication of the genetic likeness between each individual and the common waveform (genotype) associated with that population. The green colour shown on the two maps indicates a direct relationship with those traces and the genotype. When the fitness colours are red or blue it indicates a weaker genetic relationship (i.e. 1st or 2nd cousin). The weaker genetic relationships highlight areas where the seismic response has changed due to changes in reflector geometry and/or the propagating wavelet.

Image two **(2)** on the right shows a seismic inline with some of the larger GeoPopulations highlighted. Note the intrusive cutting across many of the surfaces in the Triassic section. The Seisnetics processing algorithm is able to handle the different dips within the section quite well. Image one **(1)** on the left is a mirror image of image two **(2)** showing only the larger surfaces. Examination of the density and distribution of the surfaces is often quite revealing, offering both structural and stratigraphic insights.

Two of the automatically identified surfaces are shown in the upper and lower maps as images three and four **(3 & 4)**. The upper map was created by co-rendering fitness and amplitude from a surface that is a known geohazard in the geological section. More detail about this surface is documented in a paper published in the WABS 2013 conference proceedings (Web-Link: **https://www.hightail.com/download/elNJbGtEMGNubVZsQXNUQw**).

The Top Barrow Group surface is shown in the lower map (4). Using this surface along with many other adjacent peak and trough surfaces a complete set of morphometric parameters were automatically extracted into a suite of queryable databases using GeoProxima processing. Since these databases fully describe the variability of these surfaces, SQL queries directed by the interpreter can quantitatively extract features and objects. One of the unique features of GeoProxima processing is that the technique does not use any known mathematical transforms to extract the surface properties defined by differential geometry from digital data. Unlike traditional techniques, the process was specifically designed to analyse digital data so the analysis is automatable and the results are precise without the usual artifacts. An expanded abstract of an ASEG/PESA 2013 conference paper can be downloaded from this weblink (**https://www.hightail.com/download/elNJbGtEMGNreEFYRHRVag**).



www.geoproxima.com.au

Image **(A)** shows a TWT surface interpreted as the Top Barrow group created from several GeoPopulations. The map covers an area of more than a thousand square kilometres. There is a great deal of information contained within this surface at a number of different scales. Targeting the regional elements or detailed aspects (inset image) of this surface is traditionally a very time consuming, inefficient and inconsistent process. Working with a suite of morphometric databases created by the application of GeoProxima processing to many of the surfaces identified by Seisnetics pre-interpretation processing, enables the user to focus on specific aspects of the surface(s) using simple SQL queries. Image **(B)** shows both linear ridges (convex features in orange) and valleys (concave features in blue). Each image is in response to a specific query made to the automatically created database of extracted morphometric features for each surface. The inset image here shows that each database contains high levels of detailed measurements. For example **(C)** shows the more regional features that are associated with convex and concave element pairs that are parallel to each other (i.e. faults). The inset picture of this image shows that there are thousands of measurements associated with these fault elements. In this example these elements could be used to calculate detailed measurements (e.g. fault throw, heave, verticality, etc.,).

Since we have created morphometric databases from many surfaces, they can now be examined in combination with other nearby surfaces to develop an understanding of how features and objects propagate vertically through the section. Image **(D)** has six panels (boundary, pockmarks, totcurv, faults, ccvcurvature, cvxcurvature) created by optically stacking a number of nearby surfaces. Each of these panels represents the result of a specific SQL query on a number of surface databases. When the same features occur on more than one surface within the optical stack the feature starts to brighten. When the feature is present on all surfaces, the optical stack appears white. If there is no coincidence of similar features in the optical stack then the area appears as black. The **boundary** map shows the extent of the surfaces being analysed. Here white means that there is data values from all surfaces and black indicates data is absent from all surfaces in the optical stack. The **pockmark** map shows the result of a specific SQL query targeting circular concave depressions of a particular size. The **totcurv** map shows the result of a specific SQL query targeting Total or Gaussian curvature. Total curvature is the product of the minimum and maximum curvatures that are extracted from the Dupin Indicatirx measurements made at every data point. Extreme values of total curvature provide an indication of complex deformation and fracturing. The **fault** map shows the results of a specific query, targeting features that contain parallel elements of both convex and concave lineaments. The **ccvcurvature** and **cvxcurvature** maps show detailed object geometries that are evident on multiple surfaces. Image (E) is a zoomed portion of Image (D) highlighting a small area of the surface demonstrating that the morphometirc databases can be worked at regional and prospect scales.

Images (F to K) show GeoProxima analysis of the Seafloor TWT surface. Image **(F)** shows the TWT values displayed with a rainbow false colour palette with sun angle shading. While the larger head scarps and associated runouts are visible, there is a great deal of information visually lost in the gradational colours of the palette. Moreover, the quantitative extraction of features and objects of interest, using traditional methods, would be very difficult and time consuming. Image **(G)** shows the automatically vectorized convex (orange) & concave (blue) objects that highlight and detail several different domains. Image **(H)** shows the result of a different SQL query that highlights circular concave depressions (pockmarks). Colour can be used to help highlight object variability (i.e. shape, size, and orientation). Moreover, these values can be gridded to create a density/probability map of pockmarks (shown as a gray scale in image **(I)**. Image **(I)** also shows the locations where the total curvature values are non-zero (yellow) indicating areas of more complex deformation. When combined with the pockmark density map (grayscale) shown on the same image, it is apparent that there are areas that have both high density pockmarks and indications of complex deformation. These areas probably represent instability on the seafloor and a potential geohazard. Images **(J)** and **(K)** show more detail over a smaller portion of the map area.

Seisnetics and GeoProxima pre-interpretation processing will automatically and consistently create 3D visual databases based upon structured mathematical analysis of data. These databases provide the interpreter with a new set of tools that will greatly enhance their ability to identify and extract features and objects that need to be incorporated into geomodels. The software included as a processing deliverable enables the interpreter to quickly identify objects of importance and export them to conventional interpretation packages.

For more information please contact Jim on +61 403 346 688 or jim@totaldepth.com.au