

PSEUDO-STEREO IMAGERY

ASTER STEREO AND STEREO-SATMAP

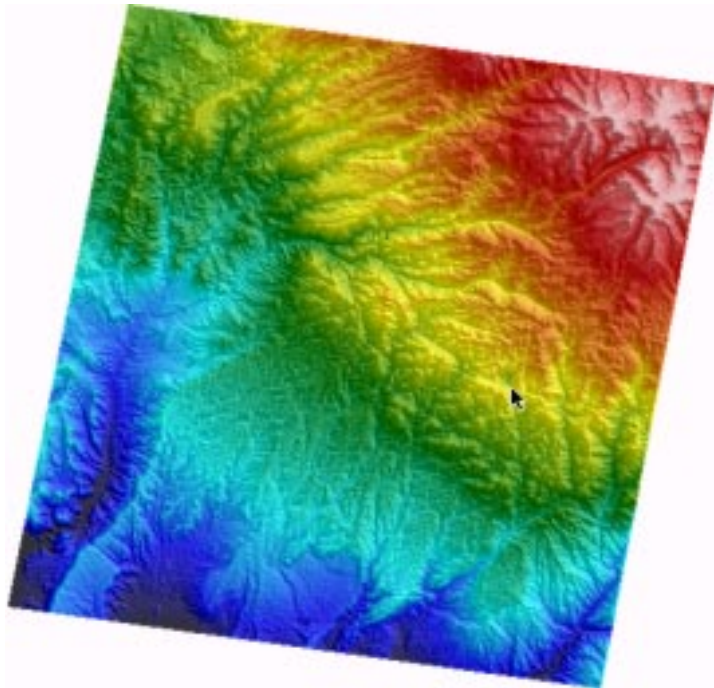
INTRODUCTION

Most Geologists/Geographers are familiar with air photos and the increased information that can be obtained from their three dimensional stereo viewing. This extra information mainly relates to the ability to estimate dip angles and to interpret structural information. With the advent of two dimensional satellite imagery, interpreters learnt to rely more heavily on spectral information in their interpretations.

Two new sources of relatively cheap DEM data are now available to produce pseudo-stereo imagery. These are DEMs created from ASTER imagery and the SRTM DEMs.

ASTER DEMS

The Aster sensor has a vertical looking near Infrared detector array, while a backward looking telescope has a detector array in the same spectral band. These infrared arrays (3N and 3B) generate an along-track stereo image pair with a base-to-height ratio of 0.6 and an intersection angle of 27.7 degrees and can be used to generate digital elevation models. GEOIMAGE routinely produces Digital Elevation Models from ASTER Level 1A scenes using **PCI Orthoengine**. The ASTER derived DEMs have a resolution of 15m and have the advantage that the associated VNIR and SWIR imagery is perfectly coregistered.

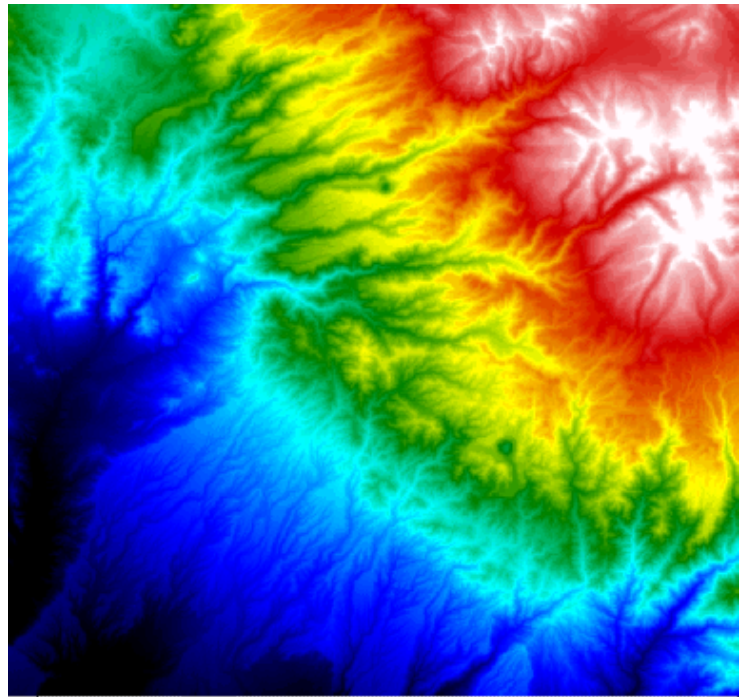
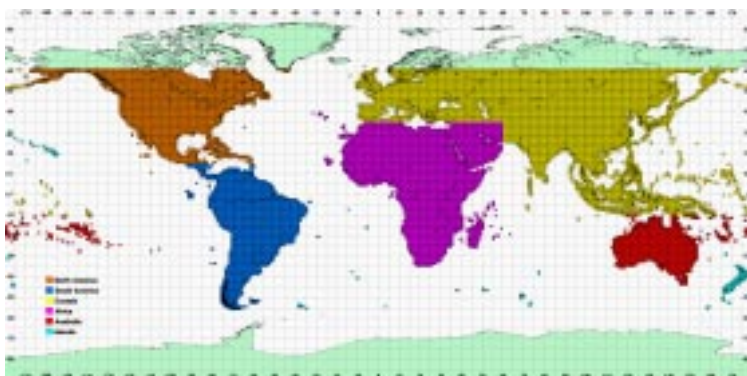


This full scene ASTER dem covers an approximate area of 60km by 60km and is over the Toquepala Mine in southern Peru - the mine is difficult to see in this enhancement (arrow) because the range of elevations within the image is 600m to 5500m.

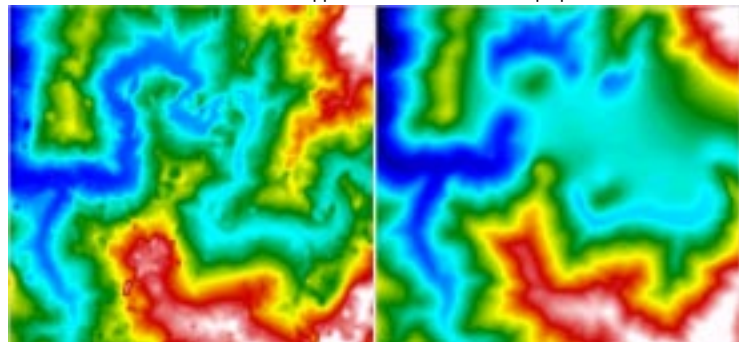
SRTM DEMS

SRTM was the primary payload on the STS-99 mission of the Space Shuttle Endeavour, which launched February 11, 2000 and flew for 11 days, and the programs aim was to generate a near-global digital elevation model (DEM) of the Earth using radar interferometry. The data is being systematically processed and preliminary unedited data has now been released for several continents.

Sample spacing for individual data points is either 1 arc-second or 3 arc-seconds, referred to as SRTM-1 and SRTM-3, respectively. Since one arc-second at the equator corresponds to roughly 30 meters in horizontal extent, the sets are sometimes referred to as "30 meter" or "90 meter" data. Unedited SRTM-3 data has been released for North and South America and for Euroasia.



SRTM 90m dem over the same approximate area as the Toquepala ASTER dem.



Comparison of an ASTER dem (left) and SRTM dem over a 9km by 9km area, Macchu Pichu, Peru.

Unedited SRTM-1 data for the United States and its territories and possessions has also been released.

DEM USES

DEMs have found increasing use in such areas as -

- Environmental monitoring - hydrological modelling of drainage basins.
- Pilot simulators - for modelling the terrain in simulators especially important in airport approaches, etc
- Defence Applications - for modelling of military missions
- Telecommunication modelling - Planning of cellular telephone networks requires a knowledge of the ground terrain and infrastructure to minimise the number of towers required.
- Cartographic Mapping - to produce contour information for topographic maps.
- Engineering applications - for planning of engineering projects such as pipeline routing, new road networks, etc
- Petroleum and Mineral exploration - geological interpretation of structure is often aided by stereo viewing of imagery as in the example below.
- groundwater flow modelling especially in relation to revegetation, and salinity mapping and modelling.
- direct exploration - geomorphology related to paleo-drainage (eg diamond exploration), regolith and land-form especially in geochem survey interpretation and planning.
- planning of airborne surveys - likely achievable survey specifications i.e. can we really do a 40m flying height survey using a fixed wing aircraft.
- agricultural assessment and planning - cropable areas

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STEREO PAIRS

Pseudo stereo imagery is prepared by Geoimage using inhouse developed software. Although modelled on the stereo viewing of air-photos, this stereo imagery is slightly different. Air photos have radially oriented stereo (or height induced distortion) by virtue of the instantaneous capture of a single airphoto using a lens system. In the pseudo stereo, the input is an orthorectified three band colour image (or a black/white single band image) and the height offset is introduced into the data in the east-west direction. It is normal to make a left and right stereo pair, where the height offsets are made in equal amounts but in opposite directions as is the case in airphotos. The amount of the height offset is usually made in a linear relationship to the range of dtm values in the image and will be dependent on the scale of the images, the type of stereoscope used and the viewing need of the interpreter (the amount of the stereo offset can be fine tuned for an individual). The normal maximum offset is 20pixels i.e. a pixel at maximum height is offset 20pixels while a point at minimum height is not offset.

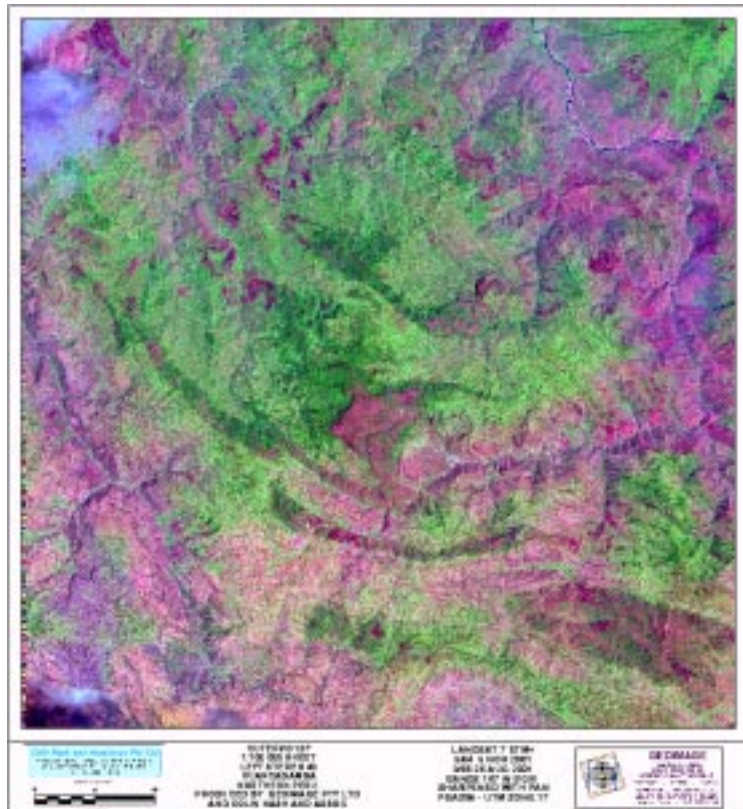
One of the problems of a stereo left-right combination is that each image is height distorted so that neither image will produce an undistorted interpretation. This can be overcome by preparing a left-vertical stereo pair with double the height offset on the left stereo image i.e. a maximum 40pixel offset, and a vertical i.e. undistorted, image with coordinate information on it. A second problem relates to the size of the image prints and trying to position them under a stereoscope. This problem is best handled by cutting the left stereo print into vertical strips and interpreting a strip at a time. The vertical print can be course be left intact.

The digital stereo images can also be examined on a computer screen and this is most easily done in ERMMapper with the images displayed in adjacent Geolinked windows. If the windows are set up with a spacing similar to the viewers eye separation distance, it is possible to view the stereo without a stereoscope

Any single band (black/white) or three band colour composite imagery can be used to produce the pseudo-stereo imagery. The optimum scale for hardcopy output will depend on the pixel size of the input imagery. For example, ASTER vnr imagery can be enlarged to 1:25 000 scale although it looks sharper at 1:50 000 scale. LANDSAT ETM+ imagery which has been pan sharpened can be enlarged to 1:50 000 scale but is sharper at 1:100 000 scale.

Dr Colin Nash has used pseudo stereo images of 100k sheets of pan-sharpened LANDSAT ETM+ for his structural/stratigraphic interpretation of the Huancabamba areas in Northern Peru and the term STEREO-SATMAP has been coined for these images.

LANDSAT ETM+ Stereo Pair (STEREO-SATMAP) of the CUTERVO (13F) 100K sheet in Northern Peru and part of the Huancabamba Multiclient interpretation Study undertaken by Colin Nash and Associates and GEOIMAGE. The Left image is a Left stereo image with maximum 40pixel offset and the right image is a Vertical image with no height displacement.

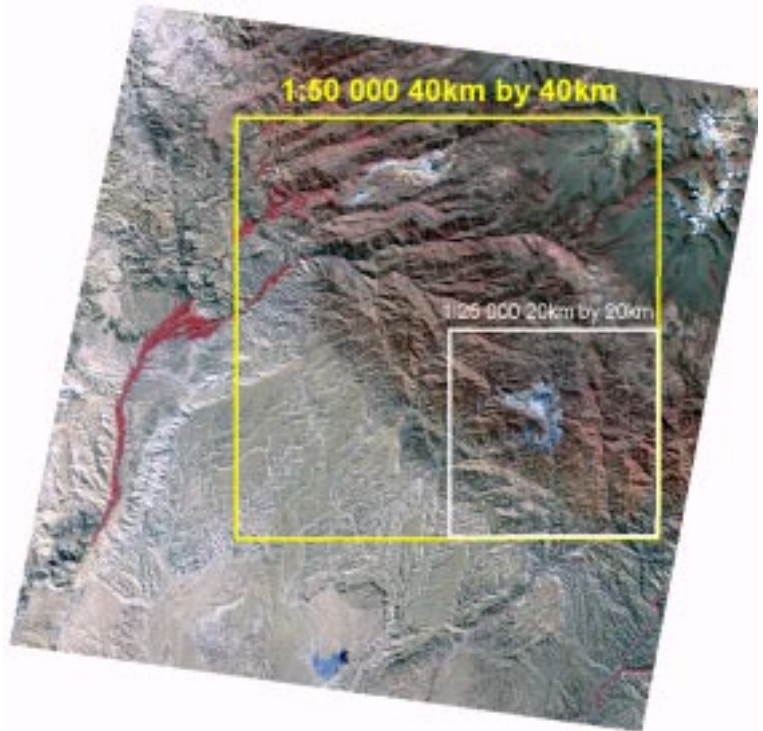


PRICES

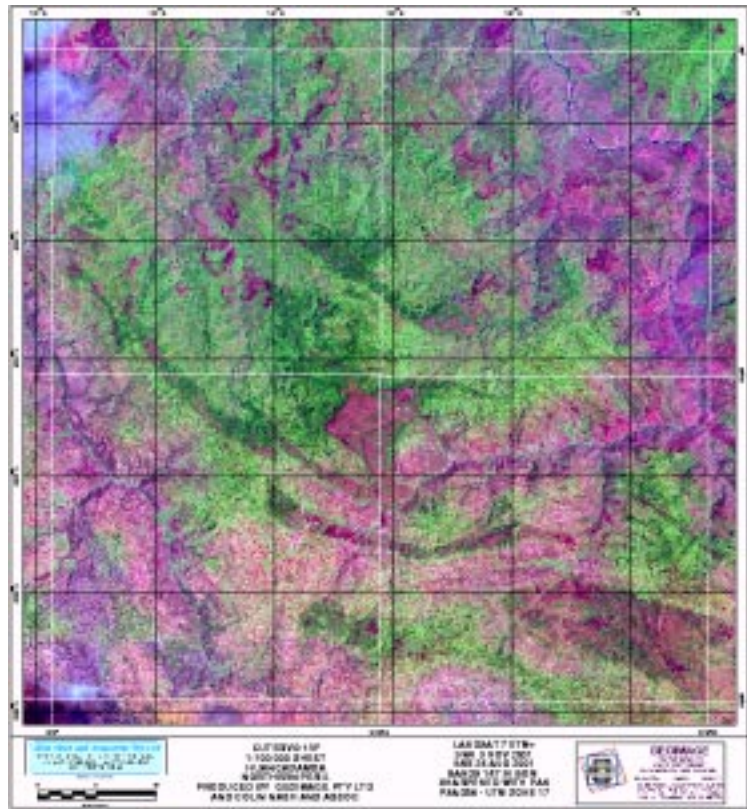
The following prices for a standard (80cm by 80cm) set of three stereo images (left, right and vertical) after the production of the DEM are presented as a guide only and it is recommended that you contact Geoimage for a quote on your specific requirements.

Scale	Australian (A\$ Inc GST)
1:25k,50k or 100k	\$1320

or A\$990 for a left/vertical pair.
+Freight and lamination if required

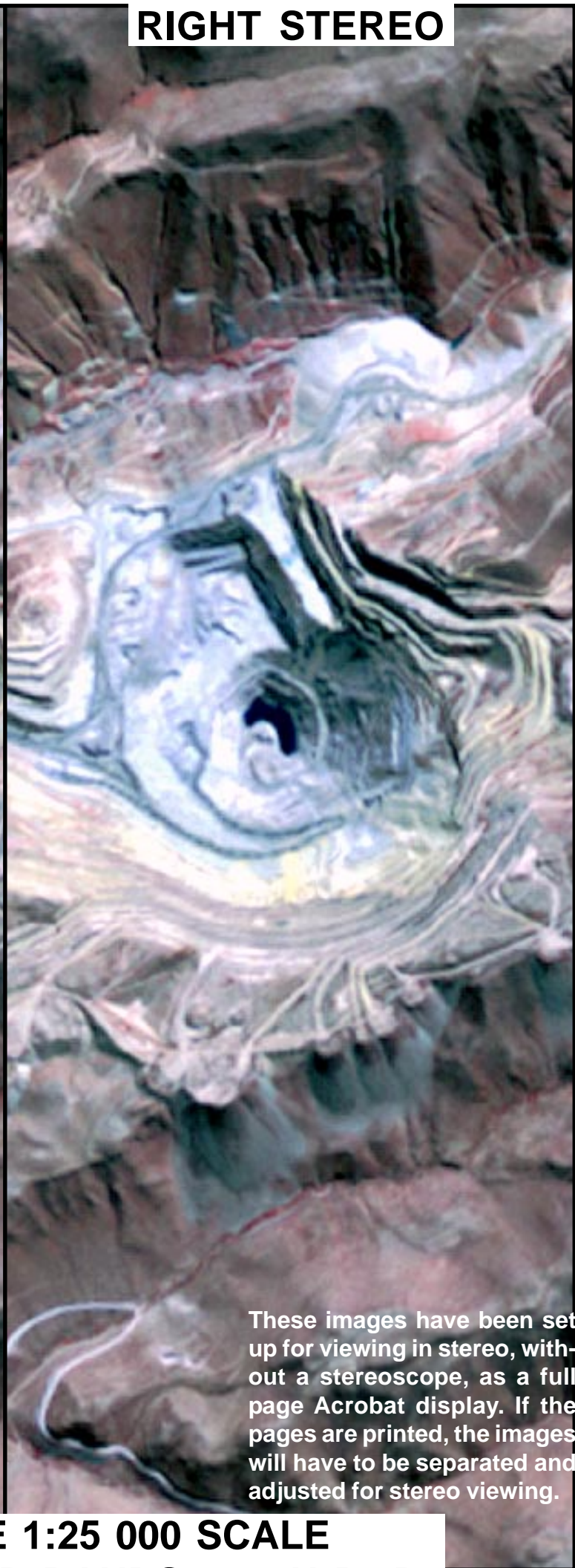
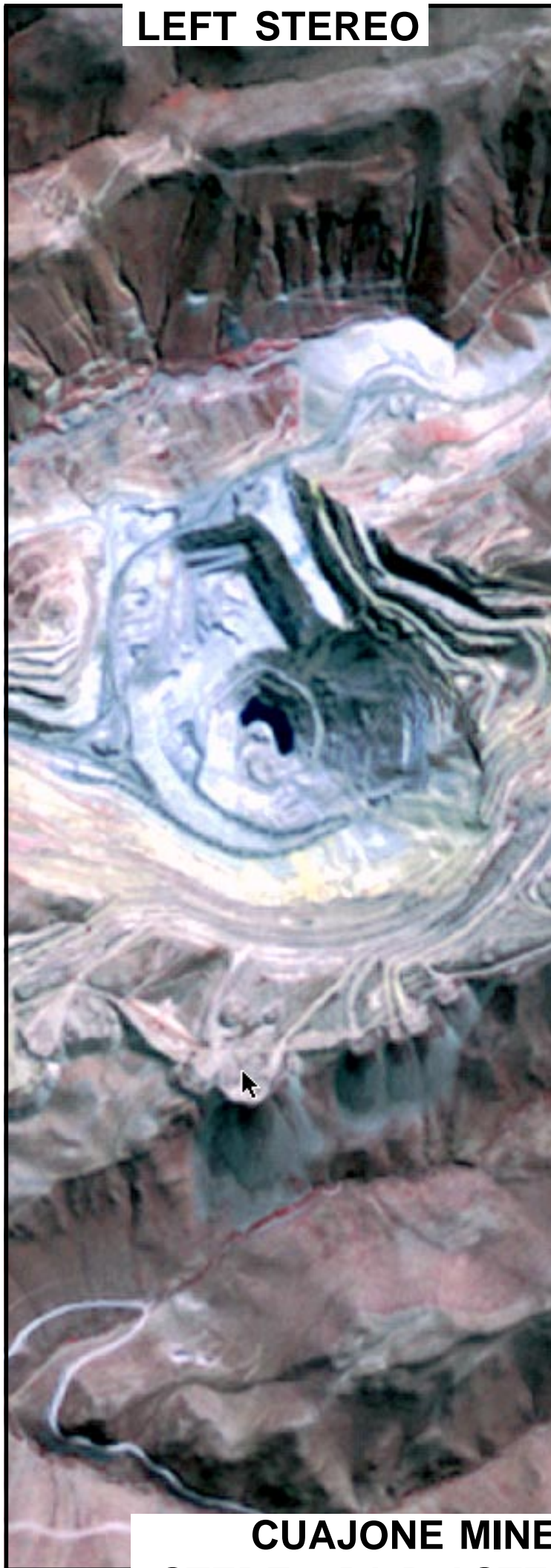


Aster image of bands 123 in BGR over the Toquepala mine showing the area covered by a standard image of 80cm by 80cm at various scales.



LEFT STEREO

RIGHT STEREO



These images have been set up for viewing in stereo, without a stereoscope, as a full page Acrobat display. If the pages are printed, the images will have to be separated and adjusted for stereo viewing.

**CUAJONE MINE 1:25 000 SCALE
STEREO PAIR ASTER BANDS 123 IN BGR**