CHAPTER III

PROCEDURE AND DATA MANAGEMENT

Preparing the foundation base imagery such as Landsat TM, ASTER. The preparation of imagery using ENVI 4 was prerequisite to actual data collection. major components are preparation of digital support materials and preparation based imagery. Procedures for Imagery Preparation for in-depth technical procedures used to prepare supporting data for data collection. Figure- 3.1 show a decision flow chart based on the availability of digital resources for initial imagery and subsequent imagery respectively.

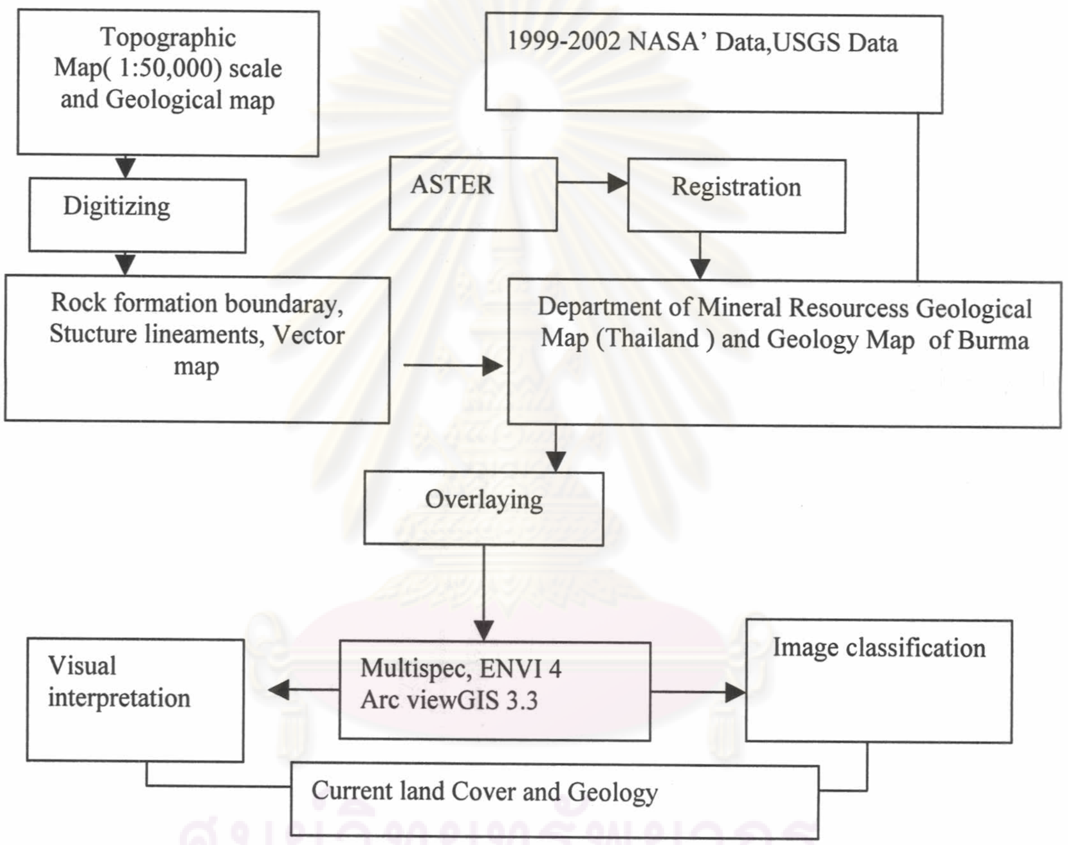

Figure-3.1. Data analysis procedure to delineate the study area using the topographic map , the NASA and USGS data.

3.1. Scanning

Raster data contain pixel values for map objects. Map information is divided among various overlays (topography, inventories of facilities, land use, forest, rock units etc.), each overlay may be scanned individually to produce data relevant to their thematic layer or class range.

The original maps topographic map A_0 size (1:50,000 scale, Edition 2-RTSD series L7017) have been scanned at 200 dpi, saved as raster images ,TIFF format.Also geological map of Thailand A_4 size (1:500,000 scale, Geological survey Division, Department of Mineral Resources,1983Edition, Editing Committee: Dr.Chonglakmani,C.,Dr. Bunopas,S., Charoenpravat,A., Nakinbodee, V.,Nakornsri,N.,Dheetadilok, P., and Sarapirome,S.) , and Geology of Burma A_4 size (1:2000,000 scale, Friedrich BENDER with Contributions of Dietrich BANNERT, Jorn BRINCKMANN, Franz GRAMANN and Dietrich HELMCKE 1981, Compiled by D.Bannert and D.Helmcke) have been scanned at 200 dpi, saved as raster images ,TIFF format (See Figure-2.3,2.4).

3.2. Image Registration

Image registration is one of the basic image processing operations in remote sensing and geographic information system. A wide range of registration techniques has been developed for many different types of applications and data such as topographic map, multispectral image , DEM and geological map. Any given set of Landsat TM image can be automatically registered. When we overlay data in the same reference systems they will align properly . Therefore, it is very important that all of the data in our spatial database use the same datum and coordinate system.

Use registration to reference images to geographic coordinates and/or correct them to match base image geometry. Registration points can be selected interactively from display windows and/or vector windows. Warping is performed using polynomial functions, or rotation, scaling, and translation selecting RST (Rotation, Scaling,and Translation) calculation. Comparison of base and warped images using ENVI's Overlay capabilities allows quick assessment of registration accuracy. For step-by-step image registration instructions (see Figure- 3.2. the Image Georeferencing and Registration).

3.2.1.Georeferencing

This standard specifies that image data be referenced to real world locations. Framework data should be referenced using the following standards for projection, coordinate system and datum. Local georeferencing should utilize a known standard such as state plane coordinate system.

3.2.2. Projection and Coordinate system

Framework will utilize Universal Transverse Mercator (UTM) grid coordinates in meters, WGS 84, and local zone 47 north. UTM zone 47 is the standard UTM zone for the area from 96 degree to 102 degree longitude. Datum standard recommends that the World Geodetic System (WGS 84) be used as horizontal datum for orthoimagery.

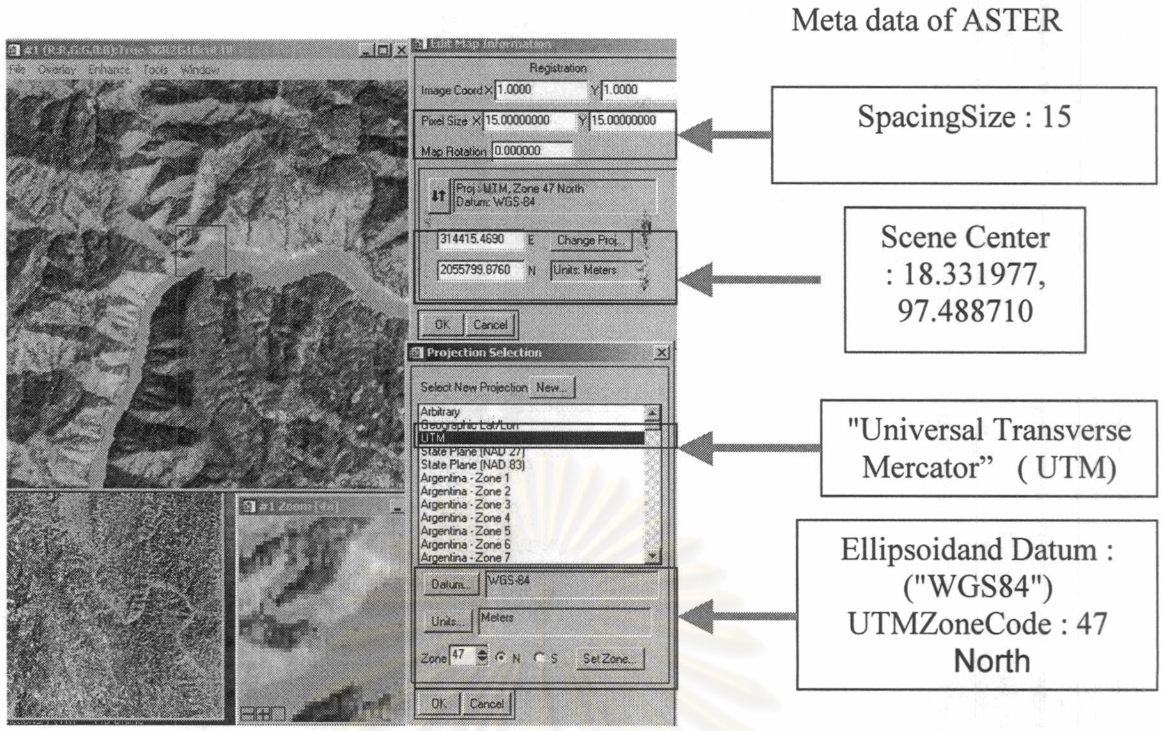

Figure- 3.2. Image showing registration of ASTER

3.3. Image Rectification

Rectification is often performed to correct images so that they conform to a specific map standard such as the Universal Transverse Mercator (UTM) projection. Registration can be performed when the scene under observation is relatively flat and the viewing geometry is known. The former condition is often the case in remote sensing if the altitude is sufficiently high. This type of registration is accomplished by rectification, i.e., the process which corrects for the perspective distortion in an image of a flat scene.

There are two general types of rectification: (1) Image to Image and (2) Image to Map. In many cases it is convenient to place an image directly in a map projection so that it can be compared to other data. However, in some cases if it is only necessary to compare to images it may make sense to simply rectify one image to another such as Landsat TM , ASTER and geology scanned image .

3.3.1.Rectification of Landsat TM, ASTER images and Topographic map

Digital image and topographic map rectification is to rectify the original images by pixels based on a certain kind of mathematical model to orthoimges or maps with geographic information. The system provides several kinds of methods for image and map rectification.

Image rectification means to make geometric rectification to original images with the known reference data and get the corresponding orthoimages to meet the requirements of interpretation and mapping. The reference data for image rectification can be the control points or the rectified maps (raster format).

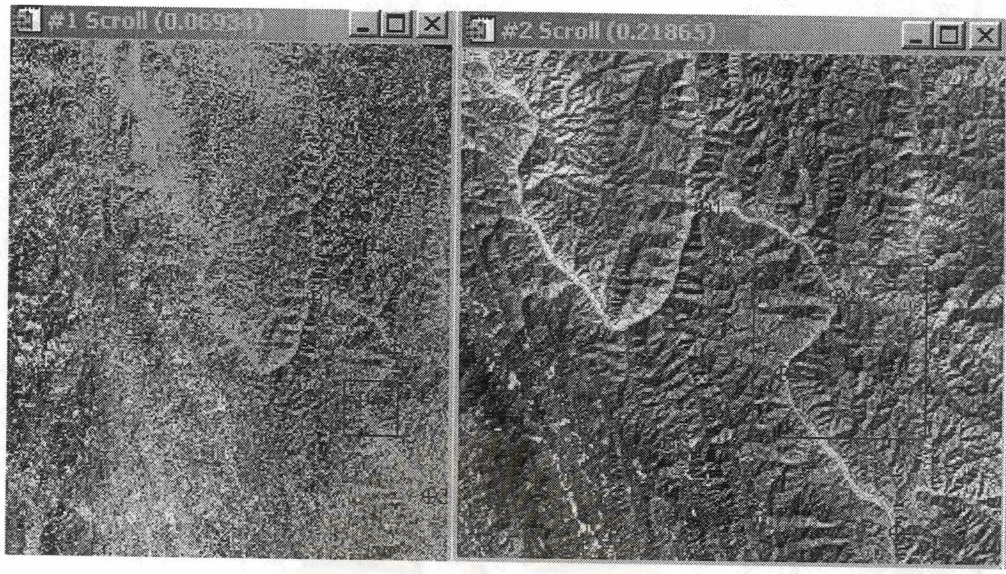

Fig-3.3. Image showing rectification points on the left ASTER and on the right Landsat TM

Especially the registration between the images that are got by different image such as Landsat TM and ASTER at different time and height in the same area, i.e. to use a rectified image with geographic information and an image that is rectified to make the registration and obtain a series of homonymous points.

In this lab , we use to retify three different images in to map coordinates, such as multispectral image topographic and geological scanned images. There are two types of retification:

1) Rectification using X, Y coordinate values
2) Rectification using GIS themes for source of map or scanned map coordinates such Topogarphic map, Thailand geological map and Geology of Burma.

In this paper using Landsat TM, ASTER images for making topographic maps at scale 1:50000, Geological map of Thailand (1:500,000) and geological map of Burma (1:2000,000) will be studied from different point of views. Including completeness (Image content) and interpretability; Moreover some accuracy standards, accuracy of Landsat TM data in topographic tasks, Stereo-measurements and methods to select necessary control points will also be evaluated.

3.3.2. Image-to-Image rectified Points

Use select rectification points, image to image to interactively select rectified points to use in image-to-image registration. Use the Zoom windows of two displayed images (image-to-image registration requires that two images be displayed) to select the rectification points. When selecting rectification points, we can select sub-pixel (fractional) coordinates. Once enough points to define a warp polynomial have been selected, rectified locations in the warp image can be predicted. rectification can be saved and restored to/from files and the color labels or symbol and ordering of the rectification points markers can be changed .

3.3.3. Collecting rectification Points (Image-to-Map registration)

Identify points in the two displayed images by locating the pixels in the Zoom windows. The pixel information is loaded into the Ground Points Selection dialog. The upper left of a pixel is the position of the whole number coordinates and the X and Y values increase to the right and bottom of the pixel, respectively. The pixel fraction available in the Zoom window is proportional to the zoom factor. Subpixel locations are supplied to provide higher accuracy in selecting rectification points.

The original maps have been scanned at 200 dpi, saved as raster images, and vectorized to obtain X, Y coordinate pairs that describe the location of geography depicted on the original maps. For the best registration, attempt to minimize the RMS error by refining the positions of the pixels with the largest errors or by removing them. Using more points can also give lower errors (see Table- 3.1. ENVI Image to Image GCP Table (Base (x,y), Warp (x,y), Predict (x,y), Error (x,y), RMS Error; Total RMS Error: 0.291289).

There are processing for image registration and imageretification as below:

- The performance of the proposed algorithm has been demonstrated by registering two multitspectral Landsat TM image and ASTER image taken in different years.
- Registration accuracy of one pixel has been achieved.
- The proposed automated algorithm outperforms manual registration by over on the average, in terms of the RMS at the retification points, as shown in the table below.
- The technique of automated image registration developed in this work is powerful and reliable in terms of its registration accuracy, computational efficiency, and degree of automation.

We can evaluate the accuracy of Landsat TM and ASTER data for topographic map(scale 1:50000). When we are selecting a source of imagery for a particular mapping task, we should consider to several important points, what data are available, they will give sufficient accuracy and required information such as geography , geomorphology and rock units.

3.3.4. Root Mean Square Error

The RMS Error is the distance between the input (source) location of a retification and the retransformed location for the same retification points. Therefore, it is the difference between the desired output coordinate for a retification points and the actual output coordinate for the same point, when the point is transformed with the transformation matrix. If the file coordinates are the source coordinates, then the RMS error is a distance in pixel widths. For example, an RMS error of means that the reference pixel is pixels away from the retransformed pixel.

The number of retification point selected is displayed in the image selection dialog. After a number of retification points sufficient enough to conduct a 1st degree polynomial warp have been selected, the total RMS error is displayed in the retification points selection dialog and the RMS error for each point is listed in the GCP List table.

The degree of polynomial used for calculating the error is displayed in the Degree box in the Selection dialog and can be changed when a sufficient number of retification points have been selected.

Base x	Base y	Warp x	Warp y	Predict x	Predict y	Error x	Error Y	RMS
2220.00	1832.00	556.00	352.00	556.10	352.27	0.10	0.27	0.29
2806.00	2207.00	865.00	549.00	864.96	548.90	-0.04	-0.10	0.11
3072.00	3230.00	1004.00	1084.00	1004.09	1084.23	0.09	0.23	0.25
2566.00	2549.00	738.00	728.00	737.85	727.60	-0.15	-0.40	0.43

Table-3.1. ENVI Image to Image GCP Table (Base (x,y), Warp (x,y), Predict (x,y), Error (x,y), RMS Error; Total RMS Error: 0.291289)

For the image rectification 4 points were used the coordinates of which were received via digitization of map in scale 1:50,000, which it was in Universal Transverse Mercator (UTM) grid coordinates in meters, WGS 84, and local zone 47 north. The RMS error for the control points was 0.43 m, which was analyzed at X equal with 0.15 m and at y equal with 0.40 m. Similarly the RMS error for the check points was 0.29m, which was analyzed at X equal with 0.10 m and at y equal with 0.27 m.

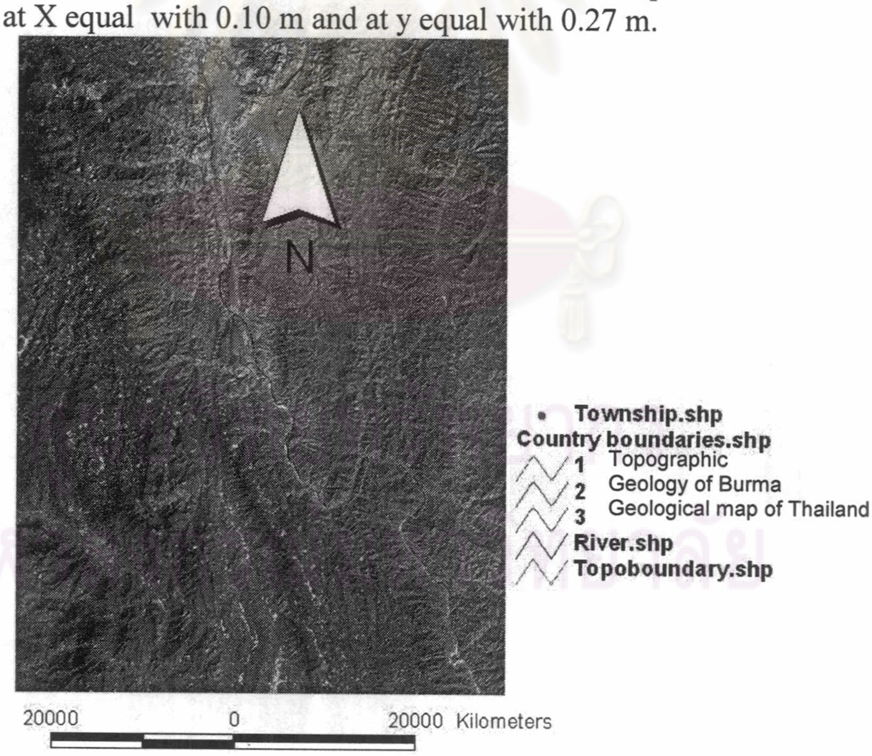

Fig-3.4. Image showing the political boundaries error

There are problems in the application of stellite remote sensing as an operational method of map compilation namely a lack of continuous stereo cover and relatively different resolution and which exist due to clouds will be solved by different sensors. The multispectral imagery into a true mapping capability providing images which can be overlayed operationally for thematic and topographic mapping at different scales such as topographic map (1:50,000 scale) , Geological map of Thailand (1:500,000) and geological map of Burma (1:2000,000) (see Fig- Image showing the political boundaries error) .

3.4. Methodology

The same procedures were followed for processing and analysis of both the ASTER and Landsat TM data. Data were first split into the VNIR-SWIR spectral ranges. VNIR-SWIR data were converted to apparent reflectance using the Multispec and the appropriate spectral response curves. Standardized analysis methods developed by Analytical Imaging data were used to analyze each multispectral dataset.

These include linear transformation of either the reflectance data (VNIR/SWIR) or emissivity data to minimize noise and determine data dimensionality, location of the most spectrally pure pixels, extraction of endmember spectra, and spatial mapping of specific image spectral endmembers. These methods derive the maximum information from the data themselves, minimizing the reliance on a priori or outside information. Many of these methods are incorporated in the commercial software package "ENVI. 4".

The digital geologic data model was constructed for the study area using the two original geological maps (geological map of Thailand,1:500,000 scale, Geological survey Division, Department of Mineral Resources,1983Edition, Editing Committee: Dr.Chonglakmani,C.,Dr. Bunopas,S., Charoenpravat,A., Nakinbodee, V.,Nakornsri,N.,Dheetadilok, P., and Sarapirome,S., and Geology of Burma 1:2000,000 scale, Friedrich BENDER with Contributions of Dietrich BANNERT, Jorn BRINCKMANN, Franz GRAMANN and Dietrich HELMCKE 1981, Compiled by D.Bannert and D.Helmcke) using the attributes given in Appendix B. The two maps were then merged, clipped to the study area boundary (latitudes between 18° 5' and 18°34' North and longitudes between 97° 15' and 97°41' East), and projected into a UTM (Universal Trans verse Mercator) projection. Lineaments were marked in the TM Scene that oriented maily in N – S, and NW - SE directions.

The parameters used standard parallels of 90° 0' 00" East and 120° 0' 00" East, latitude of origin zone 47-N-15 easting and northing, units used were meters, and the WGS 84 spheroid. The next step was to enhance the digital data by providing attributes for lithologic descriptions, and lithologic character contained in the original map unit text. To do this, a correlation matrix (similar to a correlation chart common on compiled geologic maps) was developed that relates each of the original map units to a common map unit label .The source geologic map unit labels were retained to identify what the original authors labeled the units (attribute Type; Appendix B and C). The original map unit name and entire descriptions were recorded for each unit for each map. From this, a new generalized map unit description (attributes) was developed for the common unit name (attribute Total; Table-4.1,4.2 and 4.3). Each of the new map units was then assigned attributes for age, lithologic descriptions for the primary and secondary rock types within each unit, geology characteristics, and the geomorphology of each unit.

The geospatial data transfer standard (SDTS) files given on the CD in directory entitled XYZ are stored in the geographic coordinate system (decimal degrees of latitude and longitude) instead of the UTM (Universal Trans verse Mercator) projection used for the ArcView3.3 export format for the geologic data. The reason for this is that the ESRI ArcView implementation of the SDTS format does not support UTM (Universal Trans verse Mercator) projection ,WGS84 with units of meters and zone of 47 North.

To produce geology map of 2005, we used and supervised classification (clustering) algorithms. To perform supervised classification, we create 7 training data sets made by Region Of Interest (ROIs) based on 2D scatter plotting and spectral differences in classified image, topographic features, previous knowledge and, applied maximum likelihood classifier. The maximum likelihood classification will be the probability images themselves and each input ROI used in the classification. The overall accuracy was used to perform a classification accuracy assessment based on error matrix analysis or confusion matrix.