APPLICATION OF TERRA/ASTER DATA TO NATURAL RESOURCE EXPLORATION

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ABSTRACT

ERSDAC, the Earth Remote Sensing Data Analysis Center, has conducted research and development aiming at application of Terra/ASTER (Advanced Spatial-borne Thermal Emission and Reflection Radiometer) to the field of natural resources and environment protection. The purpose of this study is to summarize the evaluation of Terra/ASTER characteristics for natural resources and to introduce some of numerous results of application for natural resource exploration and development.

1. INTRODUCTION

Since the first Earth Observation Satellite (Landsat-1) was launched, many applications for natural resource exploration and development made a great deal of effort on remote sensing. With the progress of these applications, many sensors for land observation were developed with many demands.

Terra/ASTER sensor consists of Visible and Near-Infrared Radiometer (VNIR), Short Wavelength Infrared Radiometer (SWIR) and Thermal Infrared Radiometer (TIR). Terra/ASTER sensors' characteristics are as follows;

1) 3 bands with 15m Spatial resolution in VNIR region

2) Acquiring stereoscopic data on a single orbit

3) 6 bands with 30m Spatial resolution in SWIR region

4) 5 bands with 90m Spatial resolution in TIR region. Terra/ASTER is only sensor to load multi bands in this region

5) Employing a vertical pointing function of $\pm 24^{\circ}$ for VNIR, and $\pm 8.55^{\circ}$ for SWIR and TIR

This study shows the effectiveness of Terra/ASTER data for natural resource exploration and development.

2. EVALUATION OF TERRA/ASTER IMAGERIES

The spatial resolution, DEM (Digital Elevation Model) and spectral resolution of Terra/ASTER was evaluated.

2.1 Spatial resolution

Figure 1 shows that the comparison of VNIR spatial resolution of Terra/ASTER (15m resolution), Landsat ETM+ (28.5m resolution) and JERS-1/OPS (18.3m resolution) at same place, Urayasu, Japan. It is clear that Terra/ASTER data has higher spatial resolution than the others. The shape of the residential area in the northwestern portion of the images and the roofline and color differences of the factories in the southern portion of images are clear on the image of Terra/ASTER.

2.2 DEM

Figure 2 shows that the concept of Terra/ASTER stereoscopic image. Terra/ASTER is always taking stereoscopic pair data on the single orbit. At first, nadir image (Band-3N) is taken and after then backward image is taking from same orbit about 55 seconds later. The Base-to-Height ratio of Terra/ASTER is 0.6, in other word about 25m accuracy. But statistically, the error is less than a pixel because the registration is much better than we expected.

2.3 Spectral resolution

Spectral bands assignments are shown in Figure 3. Rocks and minerals have their own spectral absorption features especially in SWIR and TIR regions. Clay minerals are characterized by the absorption in 2.2 μ m (Figure 4). Carbonates have feature of the absorption in 2.35 μ m (Figure 4). On the other hand, emissivity is affected by the contents of SiO2 (Figure 5). To classify these features and extract distributions of lithology is one of the key factors for mineral and petroleum exploration. Through this study, some data processing such as rationing were applied to Terra/ASTER data and the availability to map lithologicall distribution was ascertained. Terra/ASTER is only one sensor which has 6 SWIR bands with 10 μ m interval and multi TIR bands in the world.

3. APPLICATIONS

Based on the evaluations of the Terra/ASTER data as mentioned above, the data was expected as the strong tool for natural, mineral and petroleum, resource exploration.

For mineral exploration, it is essential to know clay mineral distribution. For petroleum exploration, it is very important to know the distribution of source rock, reservoir rock and trap (structure).

ERSDAC has conducted many research and development projects to apply spectral analysis and structural analysis for these fields in the whole world. Most of the study areas are located in arid, semi-arid and tropical rain forest areas. Remote sensing data are essential

for preliminary, reconnaissance and detailed surveys. There are many difficulties to apply remote sensing data for mineral and petroleum exploration, because usually these targets are buried in subsurface.

To extract and interpret the characters derived from remote sensing data and integrate with the other information, to apply GIS method, many potential areas for mineral and petroleum exploration was extracted.

4. CONCLUSION

High spatial and spectral resolutions will be generally required to remote sensing data interpretation of surface geology and geomorphology for mineral and petroleum exploration. As described here, it becomes clear that the Terra/ASTER data is strong tool for mineral and petroleum exploration. Performing of following functions were found to be more useful than the other earth observation satellites;

- VNIR spatial resolution
- VNIR stereo pair
- SWIR and TIR spectral performance

ASTER data could be anticipated for applying only for natural resources but also environmental, natural hazards and the other fields.

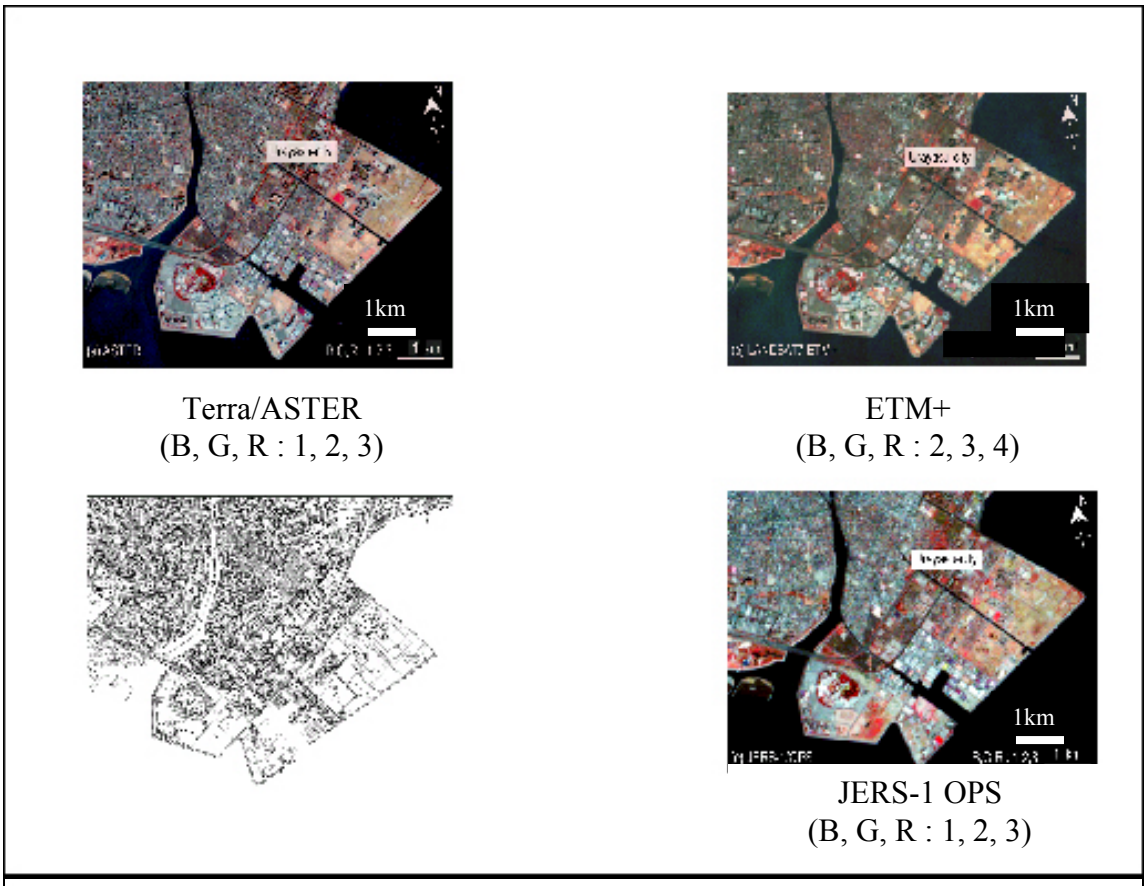

Figure 1. Comparison of the images (ASTER, Landsat ETM+ and JERS-1 OPS)

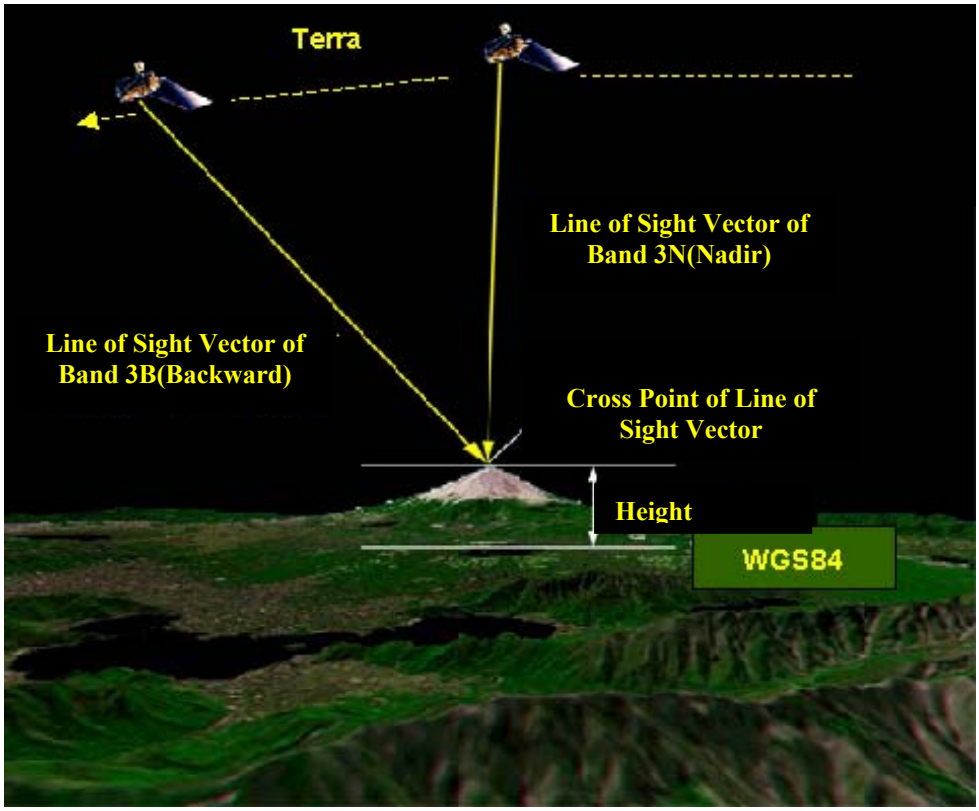

Figure 2. Principal of TERRA/ASTER DEM

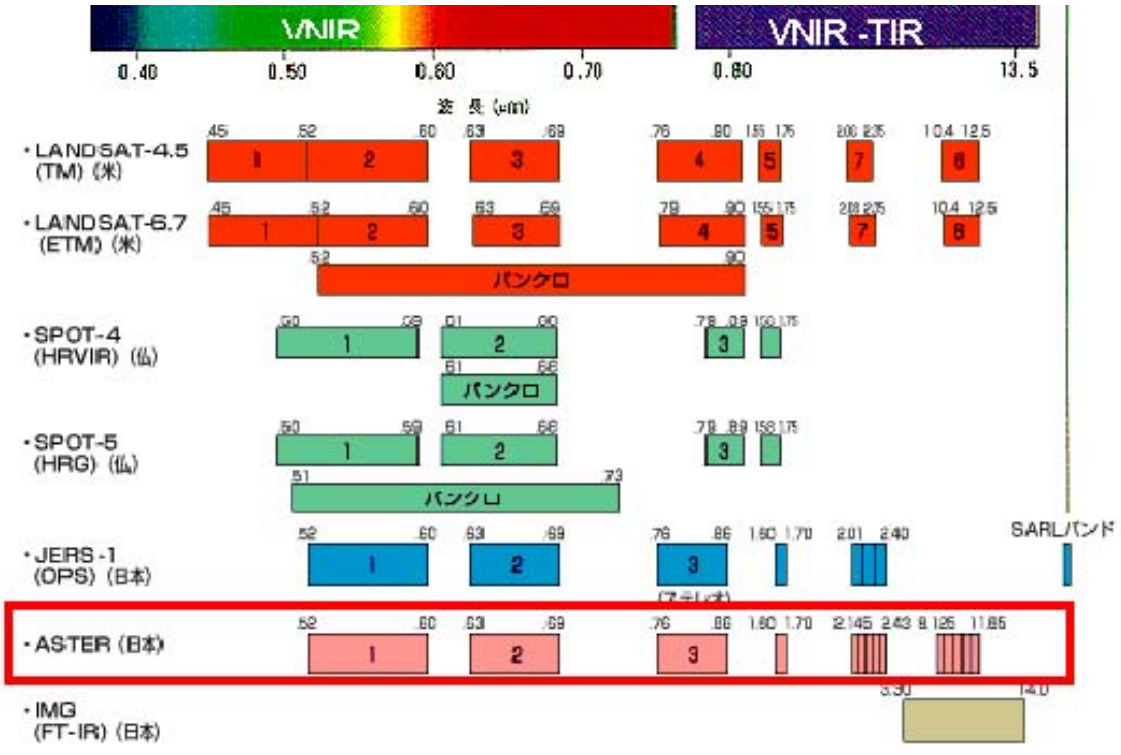

Figure 3. Satellites vs. Spectral Ranges

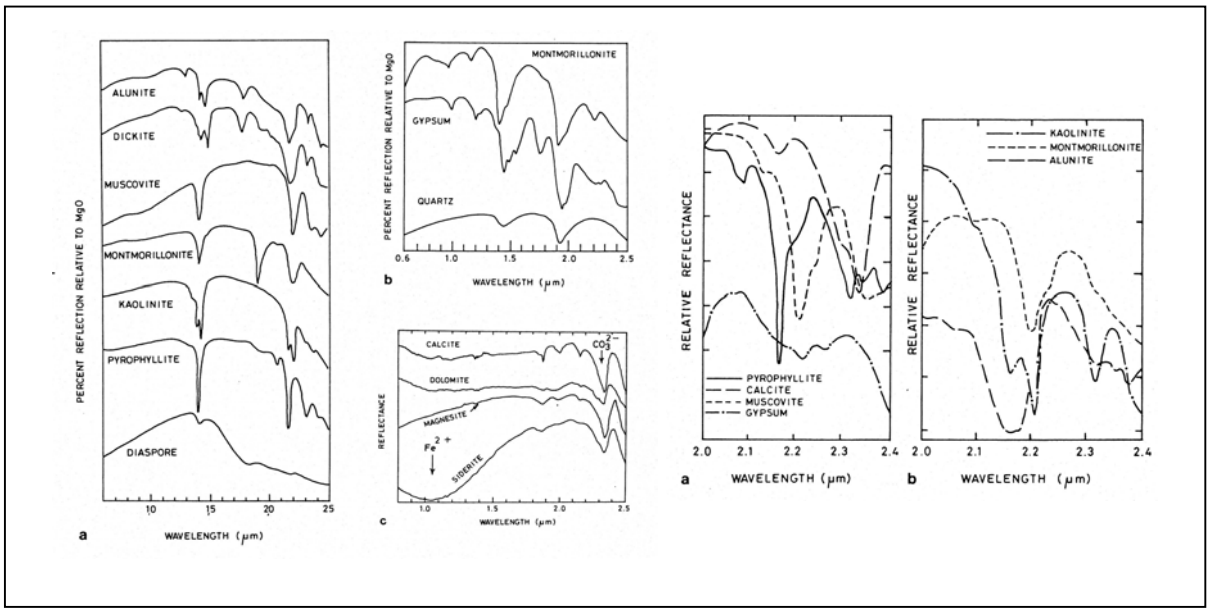

Figure 4. Spectral of minerals (SWIR)

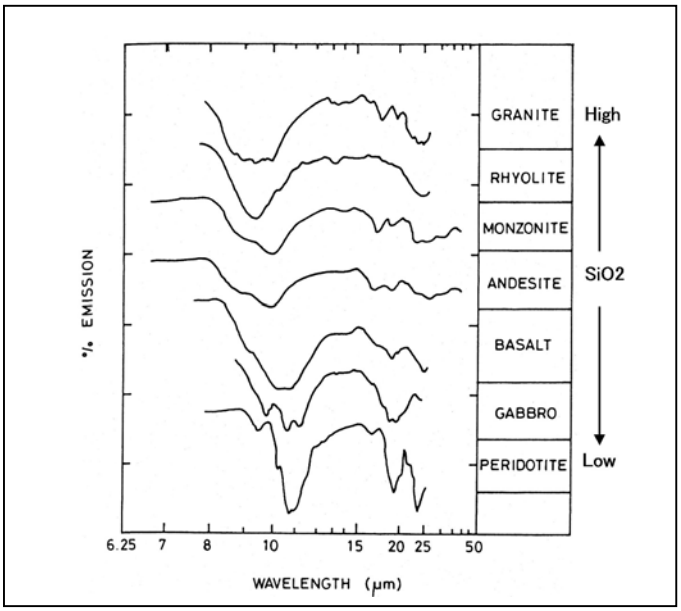

Figure 5. Spectral change of SiO2 contents (TIR)