## Multiresolution Fusion

Pan-Sharpening of Landsat Band-Ratio Images

The TNTmips Multiresolution Fusion process can be used not only to pan-sharpen satellite image bands and three-band color combinations, but also to enhance the products of various image-processing procedures carried out on a broader range of spectral bands. As one example, band ratio images, computed by dividing the cell value of one multispectral band by that of another band, are comonly used in geological interpretation of Landsat satellite images, among others. In mineral exploration, ratios of Landsat Thematic Mapper bands 3/1 (emphasizing red iron oxides), 5/4 (also emphasizing iron

oxides), and 7/5 (emphasizing clay-rich rocks) are commonly used to prospect for hydrothermal alteration zones that may be ore-bearing. The illustrations on this page show how these ratio products derived from Landsat 7 multispectral bands can be pan-sharpened in the Multiresolution Fusion process using the Landsat 7 panchromatic band (band 8) to create a more easily-interpreted spatial product. The pan-sharpening procedure not only enhances the spatial resolution of the ratio products, it also restores topographic information that aids in geologic interpretation of the images.
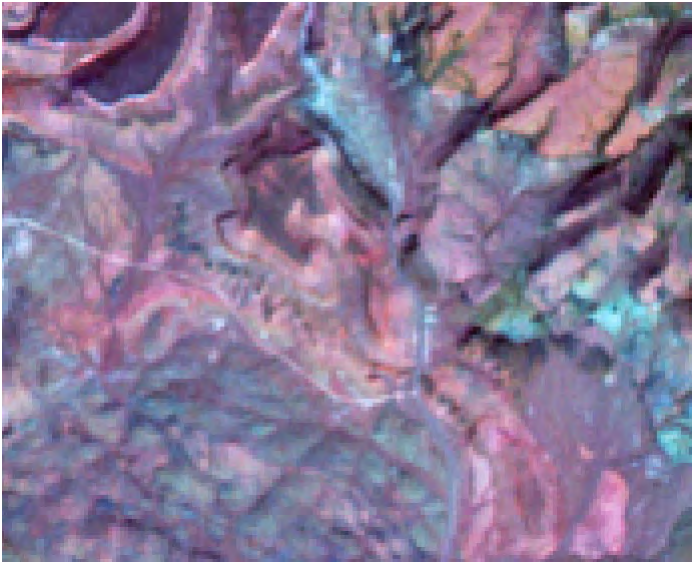

False-color display of raw Landsat 7 bands 7, 4, and 2 as R, G, and B (respectively) provides modest differentiation of surface materials for this small area of desert terrain in Nevada (width of area is 5 km).
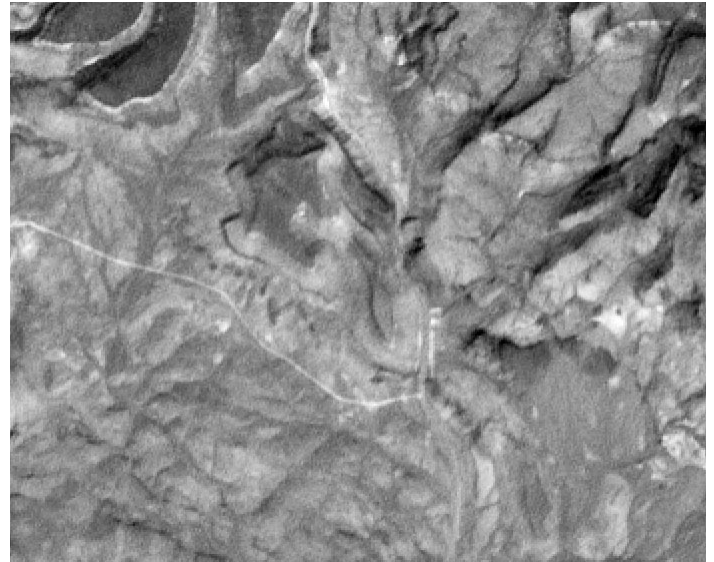
Landsat 7 panchromatic band for the sample area. This band has 15-m spatial resolution (compared to 30-m resolution for the multispectral bands).
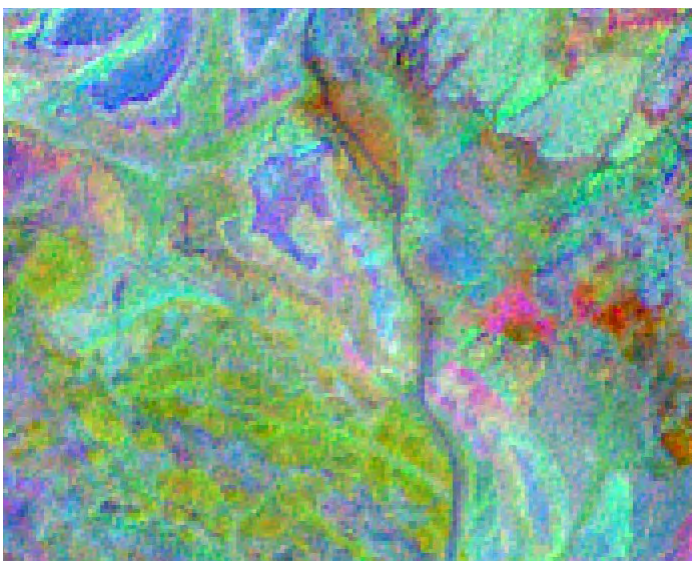
RGB display of three computed Landsat 7 band ratio raster objects for the sample area (ratio 3/1 = R, 5/4 = G, 7/5 = B). The ratio products emphasize differences in surface material composition, in part by removing tonal variations due to topographic illumination effects. Areas of different surface material are thus more clearly defined than in the RGB display of raw image bands, but the image is noisy, and the lack of topographic context hampers interpretation of geologic relationships and structure.
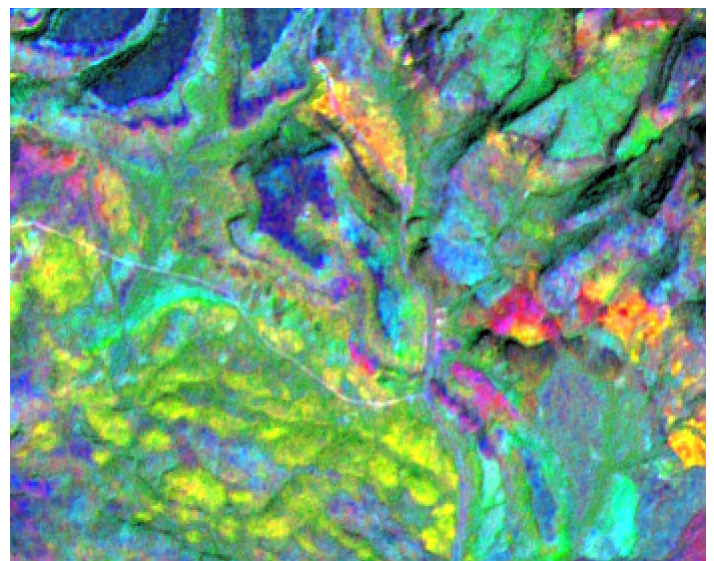
Pan-sharpened color-composite created using the high-resolution Landsat 7 panchromatic band and the three band-ratio raster objects displayed at left as the low-resolution red, green, and blue color components. Multiresolution fusion not only enhances the spatial resolution of the ratio combination, it also adds back topographic illumination and shading effects and suppresses ratio image noise, aiding both differentiation of materials and interpretation of their geologic and structural relationships.