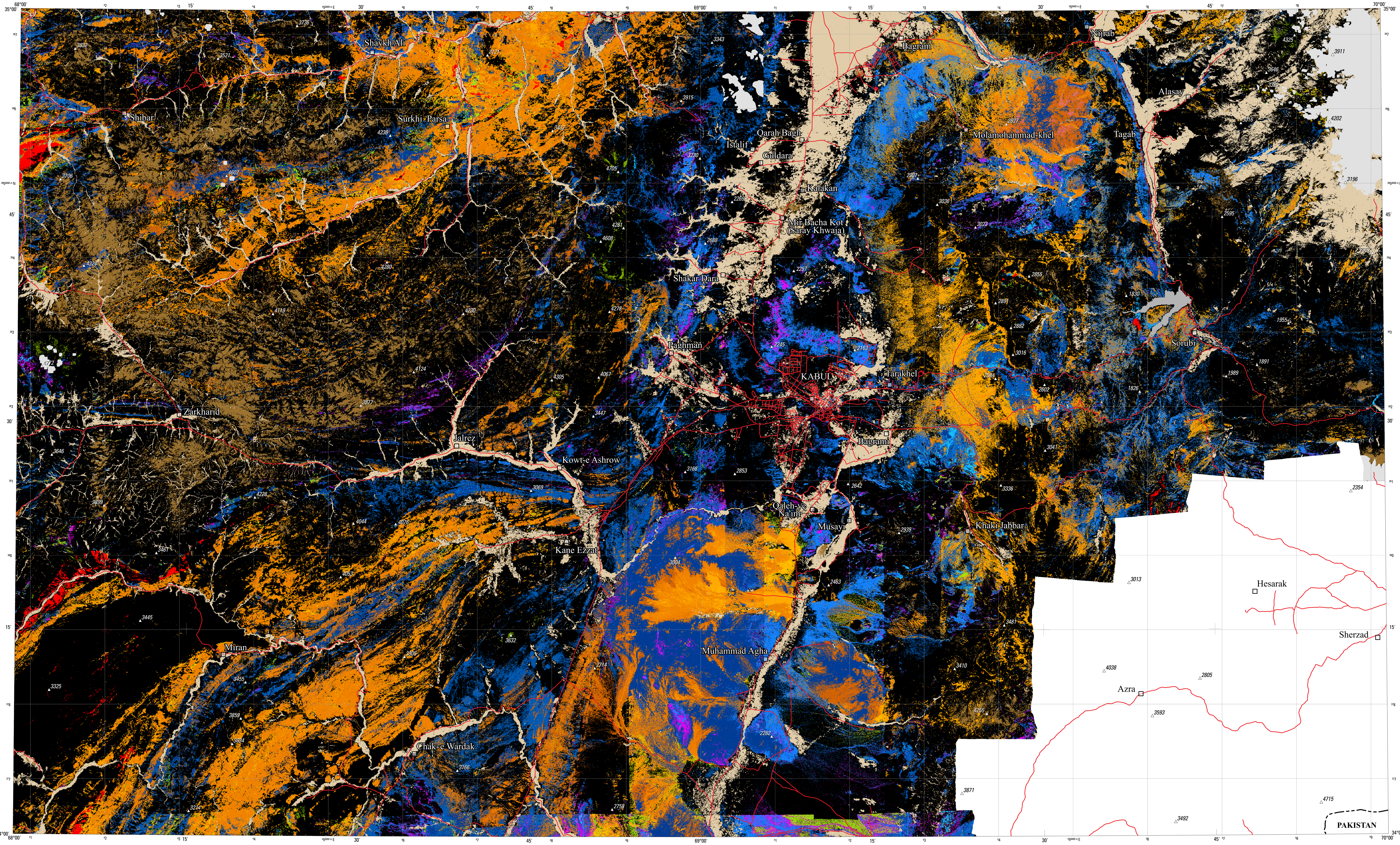
USGS OPEN-FILE REPORT 2013–1191–B
AGS OPEN-FILE REPORT (509/510) 2013–1191–B
USGS Afghanistan Project Product No. 202



Cultural data from digital files from Afghanistan Information Management Service (http://www.aims.org.af)

Projection: Universal Transverse Mercator, Zone 42, WGS 1984 Datum

SCALE 1:250 000

5 0 5 10 15 20 25 30 35 40 KILOMETERS

5 0 5 10 15 20 MILES

EXPLANATION OF MATERIAL CLASSES

[Materials are listed based on quality of match with reference spectra; class may contain one or more minerals or material types with the most likely option listed first. Number in parentheses indicates pixel count. Material classes that have small areal extent may not be visible at the publication scale of this map]

- **Hematite, nanocrystalline (94,905)**
- **Hematite, fine-grained (102)**
- **Hematite, medium-grained (533)**
- **Hematite, coarse-grained (129)**
- **Iron hydroxide (252,380)**
- **Goethite, fine-grained (1,631,108)**
- **Goethite, medium-grained (2,786,286)**
- **Goethite, coarse-grained (797,863)**
- **Goethite and jarosite (953)**
- **Jarosite (11,802)**
- **Fe^{2+} type 1 (0)**
- **Fe^{2+} type 2 (1,350,112)**
- **Fe^{3+} type 1 (173,853)**
- **Fe^{3+} type 2 (22,547)**
- **$Fe^{2+}Fe^{3+}$ type 1 (1,629,723)**
- **$Fe^{2+}Fe^{3+}$ type 2 (1,230,580)**
- **$Fe^{2+}Fe^{3+}$ type 3 (71,767)**
- **Epidote (233,844)**
- **Chlorite (3,194)**
- **Maghemite (1,250)**
- **Ferrihydrite (140)**
- **Green vegetation (2,871,426)**
- **Dry vegetation (1,336,394)**
- **Snow and ice (1,782)**
- **Cloud or cloud shadow (383,197)**
- **Water (31,428)**
- **Wet soils (181)**

OTHER SYMBOLS

[Not all symbols shown may be present on this map]

- **Not classified (19,327,259)**
- **No data**
- **Road, improved or unimproved**
- 3725 **Peak; elevation in meters**
- **City, town, or village**
- **International boundary**

DATA SUMMARY

This map shows the spatial distribution of selected iron-bearing minerals and other materials derived from analysis of airborne HyMap™ imaging spectrometer (hyperspectral) data of Afghanistan collected in late 2007 (Kokaly and others, 2008). This map is one in a series of U.S. Geological Survey/Afghanistan Geological Survey quadrangle maps covering Afghanistan and is a subset of the version 2 map of the entire country showing iron-bearing minerals and other materials (Kokaly and others, 2013). This version 2 map improved mineral mapping from the previously published version (King and others, 2011) by refining the classification procedures, especially in areas having wet soils. The version 2 map more accurately represents the mineral distributions and contains an additional mineral classification ($Fe^{2+}Fe^{3+}$ type 3).

Flown at an altitude of 50,000 feet (15,240 meters (m)), the HyMap™ imaging spectrometer measured reflected sunlight in 128 channels, covering wavelengths between 0.4 and 2.5 µm. The data were georeferenced, atmospherically corrected and converted to apparent surface reflectance, empirically adjusted using ground-based reflectance measurements, and combined into a mosaic with 23-m pixel spacing. Variations in water vapor and dust content of the atmosphere, in solar angle, and in surface elevation complicated correction; therefore, some classification differences may be present between adjacent flight lines.

The reflectance spectrum of each pixel of HyMap™ imaging spectrometer data was compared to the reference materials in a spectral library of minerals, vegetation, water, and other materials (Clark and others, 2007). Minerals occurring abundantly at the surface and those having unique spectral features were easily detected and discriminated. Minerals having slightly different compositions but similar spectral features were less easily discriminated; thus, some map classes consist of several minerals having similar spectra, such as "Goethite and jarosite." A designation of "Not classified" was assigned to the pixel when there was no match with reference spectra. Further information regarding the processing procedures is presented in King and others (2011) and Kokaly and others (2013).

REFERENCES CITED

Clark, R.N., Swayze, G.A., Wise, R.A., Livo, K.E., Hoefen, T.M., Kokaly, R.F., and Sutley, S.J., 2007, USGS digital spectral library splib06a: U.S. Geological Survey Data Series 231.

King, T.V.V., Kokaly, R.F., Hoefen, T.M., Dudek, K.B., and Livo, K.E., 2011, Surface materials map of Afghanistan; iron-bearing minerals and other materials: U.S. Geological Survey Scientific Investigations Map 3152–B, one sheet, scale 1:1,100,000.

Kokaly, R.F., King, T.V.V., and Hoefen, T.M., 2013, Surface mineral maps of Afghanistan derived from HyMap™ imaging spectrometer data, version 2: U.S. Geological Survey Data Series 787.

Kokaly, R.F., King, T.V.V., and Livo, K.E., 2008, Airborne hyperspectral survey of Afghanistan 2007; flight line planning and HyMap™ data collection: U.S. Geological Survey Open-File Report 2008–1235, 14 p.

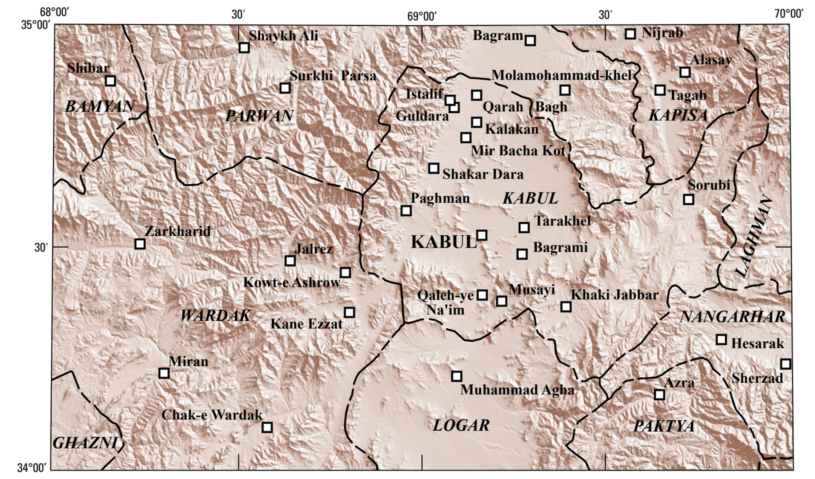
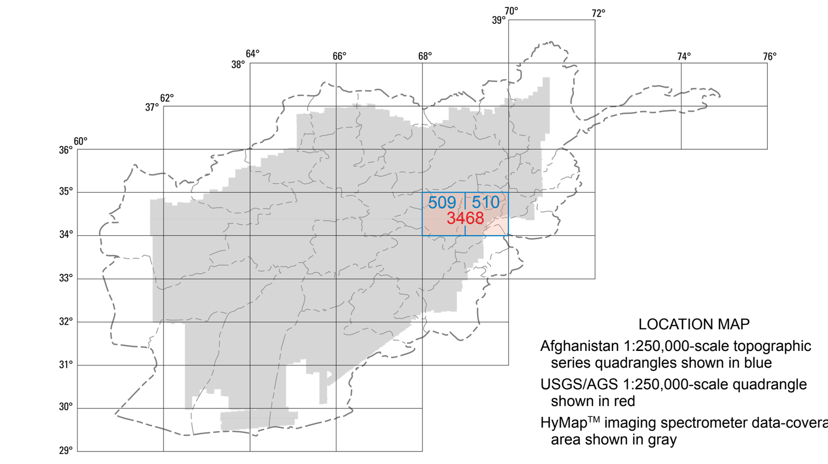


Figure 1.—Provinces and selected cities, towns, and villages in the map area. Topography is shown as shaded relief.



LOCATION MAP

Afghanistan 1:250,000-scale topographic series quadrangles shown in blue

USGS/AGS 1:250,000-scale quadrangle shown in red

HyMap™ imaging spectrometer data-coverage area shown in gray

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HYPERSPECTRAL SURFACE MATERIALS MAP OF QUADRANGLE 3468, CHAK-E WARDAK-SIYAHGIRD (509) AND KABUL (510) QUADRANGLES, AFGHANISTAN, SHOWING IRON-BEARING MINERALS AND OTHER MATERIALS

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