Simple Demonstration of the Use of Thermal Remote Sensing To Detect Buried Objects

David Nash
Department of Geology
University of Cincinnati

May 12, 2001

I have written two articles on the use of thermal remote sensing to detect thinly buried objects (Nash 1985; 1988). Detection is possible if the thermal inertia of the buried object contrasts strongly with the material in which it is buried. Under the appropriate circumstance, an object having a higher thermal inertia than the material in which it is buried will cause the overlying material to remain cooler then the surrounding area during heating cycles and warmer than the surrounding area during cooling cycles. Similarly, an object with a lower thermal inertia than the burying material will cause the area above it to be warmer during warming cycles and cooler during cooling cycles.

As discussed in Nash (1985), the surface temperature contrast between areas above the buried object and the surrounding area are a function of the depth of burial, period of the heating and cooling cycle, thermal inertia contrast, and time of observation. In Nash (1988), it is demonstrated that under the appropriate circumstances, it is possible to detect a thinly buried calcified soil horizon beneath a less than one-meter thick cover of desert alluvium.

A simple demonstration of the concept may be observed in the dew pattern that forms on the hood of an automobile. The engine must not have been run for a day or so; otherwise it will heat the hood. In the evening, as the hood cools, the areas underlain by the supporting struts (high thermal inertia) remain warmer than the surrounding unsupported sheet metal and under the appropriate circumstances (temperature, dew point, time, etc.) will remain dew free. Similarly, in the morning, as the hood is warmed by the sun, the areas over the struts will remain cooler than the surrounding unsupported sheet metal and retain the dew cover longer.

Although I have observed this phenomenon several times during the years (the correct set of circumstances occur infrequently), I never had my camera with me. On the morning of April 4, 2001 at 6:40 AM, the appropriate set of circumstances occurred and I had my camera handy. Because the dew cover is difficult to photograph, I photographed the phenomena several times from different angles. In the two best images (Figs. 1 and 2), the pattern of the underlying struts (Fig. 2) is clearly visible in the dew covered areas.

Although this demonstration is certainly not geological it is an inexpensive demonstration of the concept that has several obvious geological applications, such as detection of buried channels and faults in a thinly veneered pediment surface.

Figure 1. Image taken standing on driver's side of the automobile looking at the passenger's side of the hood. The dew covered areas correspond to the areas underlain by the supporting struts.

Figure 2. Image taken standing at the front of the automobile looking at the passenger's side of the hood

Figure 3. Supporting struts have a higher thermal inertia than the adjacent unsupported sheet metal.

References

Nash, D.B. 1985. Thermal remote sensing of faulted bedrock buried by alluvium in desert regions. *Photogrammetric Engineering and Remote Sensing*. 51:77-88.

Nash, D.B. 1988. Detection of a buried horizon with a high thermal diffusivity using thermal remote sensing. *Photogrammetric Engineering and Remote Sensing*. 54:1437-1446