THERMAL CONDUCTIVITY STUDIES OF SEDIMENTARY MATERIALS FROM CENTRAL AUSTRALIA AND THE IMPLICATIONS FOR MARS. Robert A. Craddock[1] and Marsha A. Presley[2], [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC 20560 craddock@nasm.si.edu, [2]Department of Geology, Arizona State University, Tempe, AZ 85287 mpresley@asu.edu.

Introduction: In the search for life on Mars, investigating fluvial deposits will be a high priority for future landers. Although there is abundant evidence that fluvial processes worked with great intensity in the past (e.g., outflow channels, valley networks, and modified impact craters), aeolian processes dominate under the current environmental conditions. In fact there is evidence that extensive aeolian deposits may have filled in valley networks [1] and even shallow depressions where water may have ponded [2]. Thus, quite often there may be a disparity between the geology identified by orbital data and the geology accessible to a lander. Determining where fluvial deposits occur on the surface is important for addressing NASA's goal to "follow the water." In order to do that, however, existing remote sensing data must be evaluated and a set of diagnostic criteria for recognizing fluvial deposits must be established. To that end, we are conducting a first order analysis of the thermal characteristics of fluvial and aeolian materials collected from central Australia.

Thermal Inertia: One of the most fundamental characteristics needed to describe a sedimentary deposit is grain size. Indirectly, thermal infrared data from Viking IRTM, MGS TES, and Odyssey THEMIS can provide an estimate of the grain size of martian surface materials by measuring surface temperature variations [3,4]. Thermal inertia is a measure of how rapidly the surface responds to changes in thermal energy. It is controlled primarily by the thermal conductivity of the surface material, which is itself a function of bulk density, grain size, and grain size distribution. To date there has only been one comprehensive study of the thermal conductivity of particulate materials under martian atmospheric conditions where the importance of these various characteristics were explored [5]. While this study provided many important insights on how the physical characteristics of a particulate material influences the thermal conductivity, most of the measurements were performed on glass beads. Natural materials, however, are much more complicated. For example, angularity can affect the bulk density of a material. Water can also carry dissolved salts and suspended clay that can provide bonds between the sediment grains once deposited and desiccated, thus increasing the effective particle size. To explore the thermal behavior of natural sedimentary materials, we have begun collecting a variety of samples from central Australia.

Why Australia? Central Australia is crossed by the MacDonnell Ranges, which contain a number of exposed sandstones and folded quartzite units. These materials provide an abundant source of sand for the ephemeral rivers that flow from the mountains out to the surrounding deserts, including the Simpson Desert, which is the largest sand ridge desert in the world [6]. Climatic conditions that prevailed during the last glacial maximum (about 18,000 years ago) produced hundreds of longitudinal dunes in this region that are 10-35m high and spaced ~500m apart. Rivers that terminate in the Simpson slow down and spread out onto the surrounding plain. Water evaporates or sinks into the underlying sand while sediments are deposited into a floodout [7]. Unlike the sediments emplaced by arroyos in the desert southwest U.S., which contain a large fraction of coarse materials [8], Australia's ephemerals may be a better analog because sand is the dominant sediment size and the deposits exhibit the same complex relationship between reworked fluvial deposits and aeolian contributions seen on Mars. Alice Springs, the closest urban area, is located over 100 miles (160 km) to the west while the land in between is sparsely or uninhabited. Thus, also unlike the southwestern U.S., land use has not created a problem with sediment supply and channel incision and confinement [9]. Basically, the human element as to where and how sediments are deposited is significantly reduced. In addition, most of the Northern Territory has been surveyed by a variety of airborne geophysical instruments [10]. In particular, gamma ray data provide useful information about the abundance of potassium (K), thorium (Th), and uranium (U) in soils and near-surface rocks that can be used to determine the source area for sediments. These data can also be used to assess transport distances and sediment sorting [11] so that potential sampling sites can be identified before fieldwork begins. Thus, time in the field is optimized.

Sample sites and method. Fieldwork took place over a two-week period in October 2002 and concentrated on the Ross River, a tributary to the Todd River, and the portion of the Hale River floodout located in the pastoral boundaries of Numery Station. Gamma ray remote sensing data and sieve analyses indicate that the average grain size of sediments collected within the

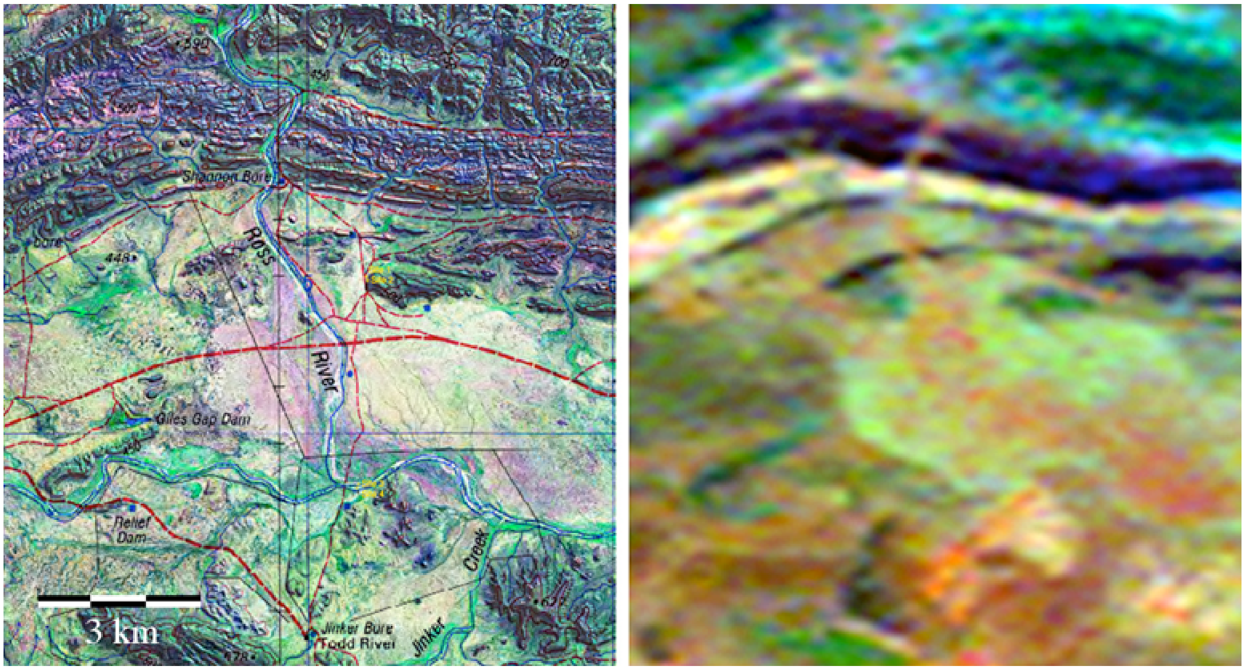

Figure 1. Left. Landsat TM image of the lower portion of the Ross River and surrounding floodplain (134° 30' E, 23° 45' S). The Ross is a tributary to the Todd River, which runs from left to right in this scene. Several samples were collected along the Ross River to determine the effects of grain size and clay content on thermal conductivity under martian atmospheric conditions. **Right.** False color image of the same area using airborne gamma ray survey data described by *Pickup et al.* [12]. The red channel contains information on potassium (K) abundances, green contains thorium (Th) and blue contains uranium (U). These data show that the Ross River contains K-rich sediments derived from sedimentary units in the MacDonnell Ranges. Values of K abundances change down channel as grain size decreases (not shown). Materials derived from igneous and metamorphic rocks are rich in Th and U and are much finer grained. These sediments are deposited onto the Ross River floodplain during periods of heavy flooding and are visible in the center of scene as bright green.

Ross River decreased downstream (Figure 1). More clay-rich materials were collected from an ancient alluvial deposit located on the Ross River floodplain as well as a paleo-channel located in the Hale River floodout. At least two different age aeolian samples were collected. The first was from a sandsheet located in N'Dhala Gorge and composed of reworked paleoalluvium from Ross River that is well-sorted and very fine grained. A coarser-grained aeolian sample was collected from a longitudinal dune in the Simpson Desert.

The method for determining the thermal conductivity of these materials under martian atmospheric conditions was described in detail by *Presley and Christensen* [13]. This suite of samples will allow us to investigate the effects of sorting, grain-size, and clay content on the thermal conductivity. We will describe the fieldwork in detail and report the preliminary laboratory analyses.

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