Intermolecular forces in coal liquefaction product distillates were recently investigated by White and Schmidt (1987) using average molar volume and average molar polarizability data. Though the evidence is not conclusive, van der Waals forces appear to be the dominate interactions in coals.

Recently NMR ^1H spin-lattice relaxation spectroscopy was used to study the mobility of hydrogen in solvent-swollen coals (Kamienski 1987), to identify the rigid and mobile components in coal structure (Tekely 1986; Jurkiewicz et al. 1987), and to delineate the thermoplastic behavior of coal during heating (Webster and Lynch 1981; Tekely et al. 1987; Sakurovs et al. 1987).

The temperature-dependent hydrogen T_1 values of oil shales were studied by Harrell and Kohno (1984) and by Miknis and Netzel (1976). Spin-spin relaxation times were reported by Lynch and Webster (1983) for Australian oil shales.

Miknis and Netzel (1976) also conducted a preliminary study on the spin-lattice relaxation time as a function of temperature for a tar sand ore and bitumen. Using both spin-lattice and spin-spin relaxation time measurements, Sobol et al. (1985) concluded that the bitumen is composed of three phases: solid-like (rigid), solid-like (mobile), and semi-liquid. They also concluded that water exists in two different environments, one in the bridges between the sand grains and the other on the clay surface.

Most of the reported research for tar sand bitumen is in the area of physicochemical characterization involving measuring the physical properties and identifying and quantifying compounds or compound types using chemical and spectroscopic techniques. Although important, the chemical characterization of tar sand bitumen provides little insight into the molecular interactions and mobility of molecules subjected to variations in temperature or solvent polarity.

An understanding of the associative properties of bitumen in its native state (tar sand ore) and in its free state (extracted bitumen) may provide the information to optimize in situ and above-ground thermal and solvent extraction processes. In addition, a knowledge of the associative properties may also provide insight for developing novel surfactant-type extraction processes or for developing environmental methods for site cleanup of residue materials.

The primary objective for the program is to investigate the chemical association and mobility of tar sand bitumen in its native state and in the free state by NMR relaxation spectroscopy. These investigations include the study of tar sand ore and bitumen when subjected to thermal stress and to solvents of different polarity.