Space Shuttle Columbia Reconstruction Effort - An Analysis of the Thermal Protection System.

Upon the breakup of the Space Shuttle Columbia, which occurred during peak heating, at an altitude of 200,000 feet, and traveling at Mach 19, the daunting responsibility was placed upon National Aeronautics and Space Administration (NASA) to determine the root cause of the accident. One of the foremost tasks was to begin locating Columbia's debris, which was scattered across a 2,000 square miles area of Texas and into western Louisiana. Each potential shuttle debris piece found was categorized and the longitude and latitude noted. This provided crucial data to the vehicle's breakup trajectory path and aided in locating key shuttle components. Since the airframe and tiles would be the primary focus during the reconstruction effort at the Kennedy Space center in Florida, packing and shipping was crucial to the preservation of the shape and condition of each recovered object. Over 83,000 pieces of Columbia, in a five-month timeframe, were located. The recovered tiles still bonded to structure indicated failures modes due to heating and aerodynamic loads. Also, different types of tile bond failure modes were observed, with adhesion failures at the Koropon layer or material failure at the tile's densification layer. Numerous tiles had the identification markings burned off, slumping of the Reaction-Cured Glass (RCG) coating, and of the LI-900 silica base material. The conditions in which the tiles were found resulted in developing methods to aid in the identification of the tile. Correctly identifying each tile was critical to understanding the heating patterns of the tiles in relationship to the vehicle, since it was known that the lower left wing received the initial external tank foam impact. With the aid of multiple disciplines, the clues found in the TPS debris, lead to the root cause of the breakup of Columbia.

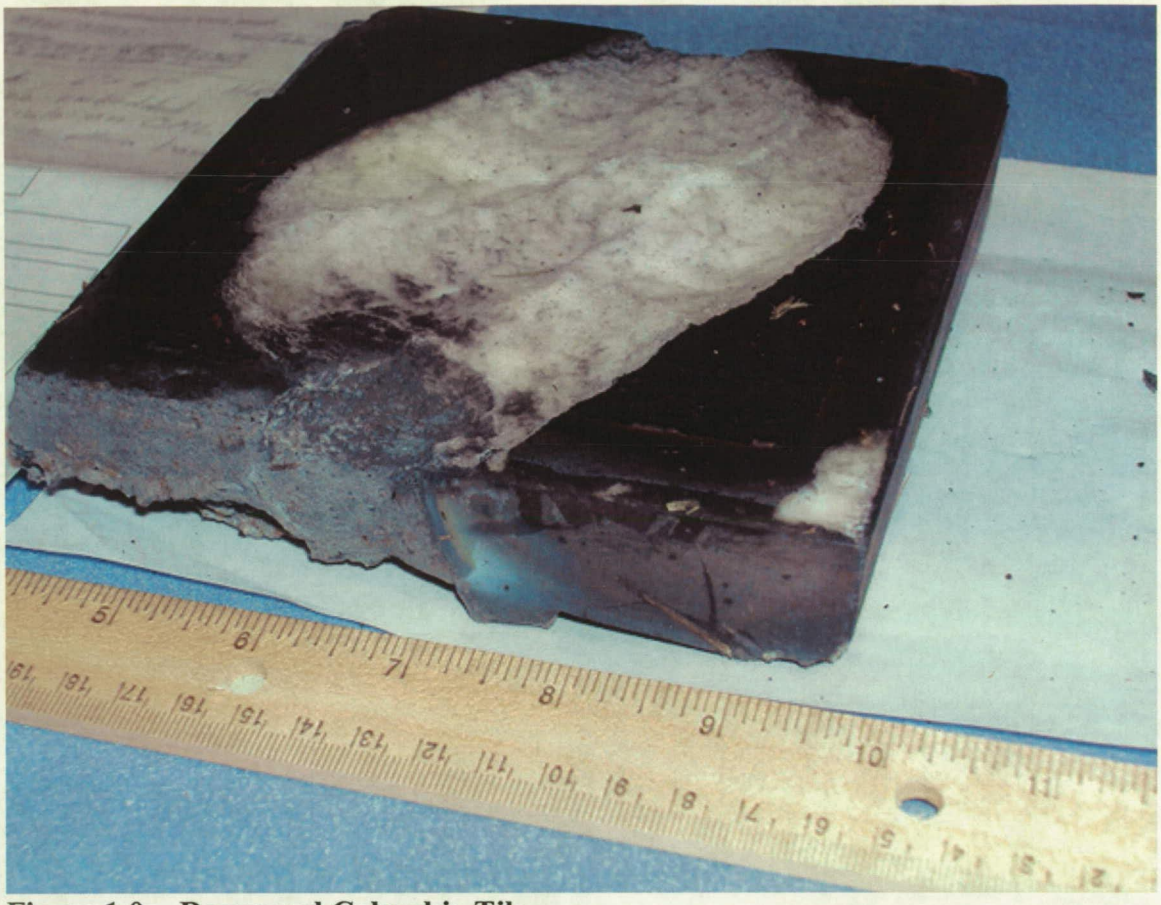

Figure 1.0 - Recovered Columbia Tile.

References:
August 2003 "Report Volume1 - Columbia Accident Investigation Board".

NASA - Human Space Flight
"http://spaceflight.nasa.gov/shuttle/archives/sts-107/investigation/caib/briefing_02252003.html."