Geologic Significance of the Hellas Region. Hellas basin spans more than 2000 km in the southern cratered highlands of Mars and is the largest well-preserved impact structure on the Martian surface. Hellas is Mars’ deepest depositional sink, with elevations as low as -8200 m in western Hellas Planitia, and has long been recognized as a source for global dust storms. The basin and surrounding highlands exhibit landforms shaped by a diversity of geologic processes, preserve exposures of Noachian, Hesperian, and Amazonian units, and extend across a wide range in latitude and elevation, encompassing the Martian mid-latitude zone where geomorphic indicators of ground ice are prominent. Geologically contemporaneous volcanism and volatile-driven activity in the circum-Hellas highlands, particularly to the east, provide resources for potential Martian life. Hellas is a significant region for evaluating volatile abundance, distribution and cycling and changes in surface conditions on Mars, given the nature and diversity of potential water- and ice-related landforms.

Research Activities. Geologic studies using Mariner 9 and Viking Orbiter images by numerous investigators have provided fundamental information on the geologic evolution of the Hellas region and interpretations of specific landforms. Mars Global Surveyor, Mars Odyssey, and Mars Express datasets are now being used to test earlier hypotheses and provide new insights into the geology and climate history of this important part of the Martian surface. The Hellas region, and in particular the eastern rim of the Hellas basin, have been foci of various research projects I have conducted with a series of colleagues over the past 15 years. Eastern Hellas includes the highlands terrains of Tyrrhena Terra and Promethei Terra, the extensive ridged plains of Hesperia Planum, the Dao, Harmakhis, and Reull Valles canyon systems, and the basin floor deposits of Hellas Planitia, along with recent ice-related landforms which include debris aprons, gully systems, lineated canyon and crater floor deposits, and partially degraded surficial mantling deposits. Research projects have employed geomorphic studies of landforms coupled with geological mapping to understand surface processes and decipher geologic history. Projects focused on the following topics have been conducted: a) explosive volcanism at the highland paterae, b) lava flow emplacement, c) canyon/outflow channel formation, d) development of fluvial systems, e) geomorphology of debris aprons, and f) impact crater populations. Current research includes studies of highland paterae, valley networks, canyon systems, and debris aprons. Formal NASA/USGS mapping projects include quadrangle mapping of Tyrrhena and Hadrira Paterae, Hesperia Planum, Reull Vallis, and Tyrrhena Promethei Terrae. Synthesis of studies of the circum-Hellas highlands to the north and east of the basin provide new constraints on the evolution of volatiles in the region, on regional stratigraphy, and on styles of highland degradation. Recent work has initiated an investigation of potential paleolakes on the basin floor.

Synthesis of Regional Geology. Eastern Hellas is characterized by an extensive history of volatile-driven activity, although the style, spatial extent, and magnitude may have varied considerably over time. The general progression from widespread valley development across the region in the Noachian Period to concentrated activity associated with large canyons in the Hesperian Period and finally to small-scale, localized flow features in the Amazonian Period may represent a transition from a water- to ice-dominated surface environment. Sedimentary plains and layered deposits in east Hellas may have been deposited in or at the margins of large, ancient standing bodies of water. Remobilization of volatiles may account for the distribution and form of younger collapse-dominated canyon segments and ice-rich flow features.

Publications in Progress: