CheMin, a miniaturized XRD/XRF instrument, has been selected for “Mars Science Laboratory” (MSL), the landed mission to Mars planned by NASA for the 2009 launch opportunity. The MSL rover will travel 10-20 km over the Mars surface over a two-year period, conducting science investigations of rocks and soils in the near-surface environment. CheMin will perform mineralogical and elemental analyses of rocks, sediments and soils in order to assess the involvement of water in their formation and search for potential mineral biosignatures, energy sources for life or indicators of past habitable environments.

The CheMin instrument is based on a 2-dimensional Charge-Coupled Device (CCD) detector capable of both spatial and energy resolution of X-ray photons. Diffraction events are collected in transmission mode to allow access to low diffraction angles necessary for the characterization of hydrous materials such as clay minerals. A novel sample-handling technique based on granular convection is implemented in the instrument to allow characterization of poorly prepared samples with grain sizes up to 150 μm. A number of proof-of-concept prototypes have been built and tested at NASA-ARC since 1995. The most recent versions are portable and have been deployed in the field for demonstration of in-situ analysis capabilities. These prototypes yield diffraction data that can be analyzed with advanced data-analysis methods such as Rietveld refinement, and diffraction profiles have full-widths at half-maximum approaching those given by typical laboratory diffractometers. As part of the design of the flight instruments, the diffraction geometry of CheMin is currently being refined.