CHARACTERIZING PLANETARY SYSTEMS: CHEMICAL ABUNDANCES OF KEPLER STARS FROM KECK/HIRES FOLLOW-UP SPECTROSCOPY

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A comprehensive, homogeneous chemical abundance analysis of planetary host stars discovered by Kepler is proposed. Precise stellar parameters (effective temperature and surface gravities) and abundances of up to 20 elements (Li, C, N, O, Na, Mg, Al, Si, S, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, and Zn) will be derived for the highest priority Kepler Object of Interest (KOI) host stars using high-resolution echelle spectroscopy being obtained with the High Resolution Echelle Spectrometer (HIRES) and 10-m Keck I telescope as part of the Kepler Follow-up Observing Program (FOP). There are four main goals of this project: 1) Derive precise stellar parameters that will contribute to the characterization of KOI host stars; 2) Identify correlations between KOI host star metallicities and planetary system characteristics (mass, semi-major axis, orbital period, eccentricity, etc.); 3) Chemically characterize KOI host stars by deriving abundances of numerous elements; and 4) Search for chemical signatures of planet formation processes. The proposed abundance analysis will contribute directly to Kepler project efforts to deduce planet and stellar host properties, and the Kepler primary scientific objective to identify correlations between the presence and characteristics of planetary systems with stellar properties of the host stars. Precise stellar parameters will constrain stellar luminosity classes (dwarf, subgiant, giant) and stellar radii, the latter of which are needed to determine planet radii. Metallicities will be derived with uncertainties of approximately 0.05 dex, allowing for meaningful comparisons to planetary system characteristics. Deriving the abundances of numerous elements will allow a complete determination of host star metallicities, as opposed to assuming a scaled-solar metallicity, and if the abundances of individual elements, such as Li, are correlated with planetary system characteristics. Patterns in element-to-element relative abundances can be investigated to search for vestiges of planet formation processes. Early results from Kepler suggest that Neptune-size and smaller planets are much more common in the Galaxy than the Jupiter-type giant planets that currently dominate the sample of known exoplanets. The proposed abundance analysis will establish the chemical signatures of stars with small planets, including those with Earth-size planets, and place critical constraints on planet formation models. This project is highly complementary to Kepler Science Team activities and will enhance the scientific value of the Kepler Mission.