Appendix C: Gamma-Ray Background Signals

C1. Types of Backgrounds in the GRS

[59] There are five possible sources of discrete-energy gamma ray photopeaks in GRS spectra: the decay of radioactive elements on the spacecraft (S_R), prompt gamma-ray emission by the excitation of spacecraft materials by spacecraft-incident GCRs (S_B), delayed gamma-ray emission resulting from long-lived activation of spacecraft materials by spacecraft-incident GCRs or solar-originating energetic particles (S_A), excitation of spacecraft materials by spacecraft-incident, planet-originating neutrons (S_N), and finally the planet-originating gamma rays of interest (S_P), where S represents the measured count rates from each of these sources. The components S_R, S_B, S_A, and S_N are sources of background, and S_P is used to measure the elemental composition of the surface. Contributions to the measured gamma-ray signals from each of the background sources must be carefully removed in order to determine the magnitude of the signal originating from the surface.

C2. Background Removal

[60] The decay of radioactive elements on the spacecraft (S_R) is observed in the GRS as the result of K, Th, and U contamination in spacecraft materials. Since the long-lived radioactive isotopes of each of these elements has a half-life $t_{1/2}$ of 10^9 years or more, their backgrounds are treated as constant over the life of the mission. S_R for each photopeak

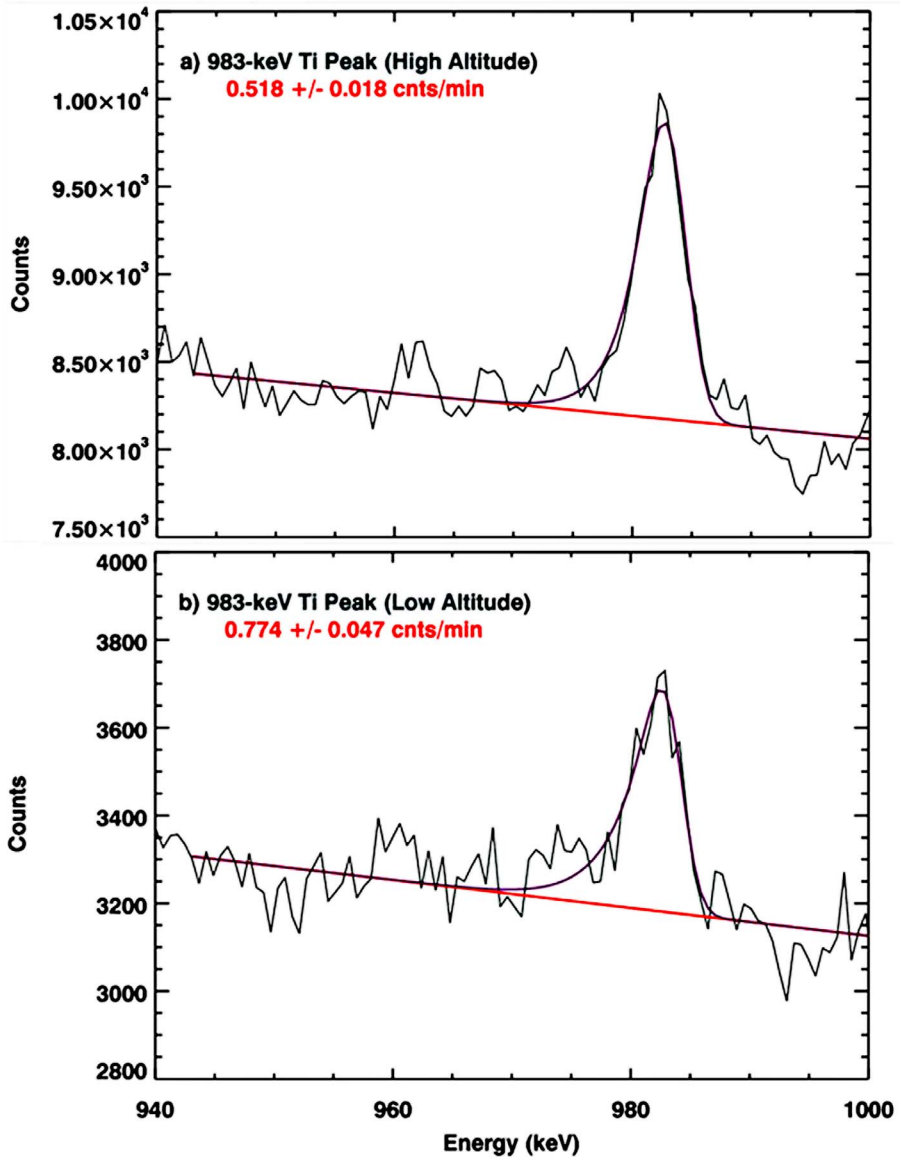

Figure C1. (a) High-altitude and (b) low-altitude fits to the 983-keV Ti peak used to determine the background amplification factor. The fits utilize near-nadir (<15°) data from the first 59 days of orbital operations, ensuring complete coverage of the surface as well as limiting contributions from time-dependent variations in the spacecraft-incident GCR flux and spacecraft activation from solar energetic particles events (e.g., 4 June 2011).