The recent observations of the anomalous cosmic ray (ACR) energy spectrum as Voyagers 1 and 2 crossed the heliospheric termination shock have called into question the conventional shock source of these energetic particles. We suggest that the sectored heliospheric magnetic field, which results from the flapping of the heliospheric current sheet, compresses across the termination shock and reconnects in the subsonic flow of the heliosheath. Dropouts in the intensity of energetic electrons and the most energetic ACR ions as Voyager 2 exits the sector zone support the hypothesis that the heliosheath sectored field has reconnected. The sector structure is examined with global MHD simulations of the heliosphere. Particle-in-cell (PIC) simulations in 2-D and 3-D reveal that the sectors break up into a bath of elongated magnetic islands and that most of the magnetic energy released goes into energetic ions with significant but smaller amounts of energy going into electrons. The most energetic particles gain energy as they circulate in contracting magnetic islands, a first order Fermi process. The simulations also reveal that the firehose condition plays an essential role in the reconnection dynamics and particle acceleration. An analytic model is constructed in which the Fermi drive, modulated by the approach to firehose marginality, is balanced by convective loss. The ACR differential energy spectrum takes the form of a power law with a spectral index slightly above 1.5. The model has the potential to explain several key ACR observations, including the similarities in the spectra of different ion species.