The surface temperatures of active lavas relate to their cooling rates, chemistry, and eruption style. We present results obtained from the analysis of 61 hyperspectral satellite images of terrestrial lavas acquired by NASA’s Earth Observing-1 Hyperion instrument, which document the surface temperature distributions of active lavas erupted at 15 volcanoes. Images were selected to encompass the range of common lava eruption styles, specifically, lava fountains, lava flows, lava lakes, and lava domes. Our results reveal temperature distributions for terrestrial lavas which correlate with composition (using maximum resolved temperature as a proxy) and eruption style. Maximum temperatures observed for basic lavas are ∼200 °C higher than for acidic lavas. All eruption styles exhibit a low temperature mode at ∼200-300 °C, while lava fountains and aa flows also exhibit a higher temperature mode, at ∼800 °C. The simplest explanation for the observed differences between the temperature histograms is the contrasting rates at which the lava surfaces are thermally renewed. Eruption styles which allow persistent and pervasive thermal renewal of the lava surface (e.g. fractured aa lava crusts) exhibit a bimodal temperature distribution: eruption styles which do not (e.g. the continuous crust of pahoehoe lavas) exhibit a single mode. We conclude that chemistry and eruption style can only be resolved remotely via the analysis of a large spatio-temporal sample of data. This has implications for determining chemistry and eruption style at extraterrestrial bodies, such as Io, for which relatively few data, and no in-situ validation, are available.