Supporting Information Text S2

Multibeam bathymetry processing and analysis

Factors that influence bathymetric data quality include the sonar system type, frequency, beam width, beams per ping, and survey speed. Those variables for each survey can be found in Table 1. Table S1 lists the multibeam files used to create each bathymetric grid. It also details the individual data processing techniques for each survey, which varied slightly depending on the data quality. All of the bathymetric survey data were processed using MB-System software. All multibeam files were cleaned using "mbedit". Grids for each survey were created using the "mbgrid" command. The same gridding parameters were used for all the survey grids. After analyzing the data it was determined that a 25 m grid cell size was optimum as it did not introduce gridding artifacts, even at the volcano base (3000 m) when gridding the lower-quality data collected in 1996.

Next, depth difference grids were created using the GMT (Generic Mapping Tools) "grdmath" command. Newer surveys were compared to the previous to determine any geologically reasonable depth changes. The difference grids were brought into ArcGIS, contoured, and polygons were created based on those contours. (The ArcGIS definition of a polygon is a closed shape defined by a connected sequence of x,y coordinate pairs, where the first and last coordinate pair are the same and all other pairs are unique.) Depth changes ≥ 30 m were polygon constrained for the 1996 to 2008 period, based on *Clague et al*. [2011]. Due to the higher data quality of the more recent surveys from 2008 to 2012, geologically reasonable depth changes ≥ 10 m were polygon constrained.

Bathymetric grids were also compared using QPS Fledermaus surface difference tools and the polygon constraints described above. Those surface difference tools were utilized to provide the surface area and volume calculations presented in Table 2.

Supporting figure captions (Figure S1, Figure S2, Figure S3)

Figure S1: Slope maps derived from bathymetric data, overlaid with bathymetric contours and depth difference polygons. Small green dots are summit eruptive vents. a) Slope and bathymetric contours of the 06/96 survey. b) Slope and bathymetric contours of the 11/08 survey. Black polygons display depth changes for PI. Same area as Figure 3b. c) Slope and bathymetric contours of the 05/09 survey. There were no depth changes during PII. Same area as Figure 3c. d) Slope and bathymetric contours of the 05/10 survey. Black polygons display depth changes for PIII. Same area as Figure 3c. e) Slope and bathymetric contours of the 12/10 survey. Black polygon displays depth change for PIV. Same area as Figure 3c, but depicting depth changes shown in Figure 3d. f) Slope and bathymetric contours of the 11/11 survey. Black polygons display depth changes for PIV+PV and PV. Red boxes depict the areas of maps a – e. Same area as Figure 3f.

Figure S2: Bathymetric soundings, ship tracklines and speed information for the surveys and areas shown in Figure S1. Yellow polygons, also the same as in Figure 3 and Figure S1, indicate areas of depth changes that occurred over the period. For example, depth changes shown of Figure S2b occurred sometime between 06/96 and 11/08 (PI). Black dots show the individual bathymetry soundings, which are the beams on each ping. Red lines and arrows indicate the ship track and direction, respectively. Speeds are at the arrow location, although they vary within a data file. Average speeds per survey are presented in Table 1. Green dots are summit eruptive

vents. a) Soundings and ship track of 06/96 survey. b) Soundings and ship track of 11/08 survey. Yellow polygons display depth changes for PI. c) Soundings and ship track of 05/09 survey. There were no depth changes during PII. d) Soundings and ship track of 05/10 survey. Yellow polygons display depth changes for PIII. e) Soundings and ship track of 12/10 survey. Yellow polygon displays depth change for PIV. f) Soundings and ship track of 11/11 survey. Yellow polygons display depth changes for PIV+PV and PV. White boxes depict the areas of maps a – e.

Figure S3: Bathymetric soundings, ship tracklines and speed information for the surveys differenced that depicted the depth changes between 5/10 and 11/11 (PIV+PV) on the WSWRZ deep eruptives and changes between 12/10 and 11/11 (PV) at and near the summit. a) Ship tracklines from the six surveys represented in Fig. 3. White box depicts the area of map b. b) Soundings and ship track of the 11/11 survey. White boxes depict the areas of maps c – f. Yellow polygons indicate depth changes between 5/10 and 11/11 (PIV+PV) on the WSWRZ deep eruptives and depth changes between 12/10 and 11/11 (PV) at and near the summit. Similar area to Figure 3f. c) Soundings and ship tracks of the 5/10 expanded survey in the area of the WSWRZ deep eruptives. Yellow dashed polygon depicts future depth change area when compared to the 11/11 survey (PIV+PV). d) Soundings and ship tracks of the 11/11 expanded survey in the area of the WSWRZ deep eruptives. Yellow polygon indicates the depth changes that occurred in that area during PIV+PV. e) Soundings and ship track of the 12/10 survey in the summit area. Dashed yellow polygons depict future depth change areas when compared to the 11/11 survey (PV). f) Soundings and ship track of the 11/11 survey at and near the summit. Yellow solid polygons indicate depth changes at and near the summit between 12/10 and 11/11 (PV).