

## Analysis of a Suggested Major Eruption of Steamboat Geyser on 21 February 2007

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### Summary

Individuals touring Norris Geyser Basin on 21 February 2007 made observations that suggested Steamboat Geyser had a major eruption on that day. Additional observations, temperature data, and water flow data do not indicate a major eruption. However, Steamboat did experience forceful minor eruptions on 11 February (2:40 a.m. MST) and 21 February (2:00 a.m. MST).

### Introduction

On 22 February 2007, YNP geologists received two email reports of a potential major eruption of Steamboat Geyser from Stacy Vallie (YNP Public Affairs Office) and Carolyn Loren (YNP Interpreter, Old Faithful).

Email from Stacy Vallie on 22 February 2007, 9:04 am.

*Email from Mike Keller ([KSCOPE\\_YNP@peoplepc.com](mailto:KSCOPE_YNP@peoplepc.com))*

*There is an unconfirmed report that Steamboat erupted within the past 24-48 hours. The following was reported to Bonnie Schwartz, Old Faithful Sub-District Ranger this afternoon (2/21) by a female guide (I didn't get the guide's name):*

*"Steamboat Geyser appears to be ready to erupt. It is sending a plume of steam several hundred feet into the air, and Cistern Spring is draining." The guide said Cistern dropped 2cm in the 20 minutes they watched it. Now before you say "Steamboat erupted", the guide neglected to mention anything about ice, wash, snowmelt, or mud in the area. Instead, she said the bacteria mat looked thick in the runoff channel. She also told Bonnie there were no footprints in the snow and that her party appeared to be the first one to visit the area in days. YNP has been hit with a heavy snowstorm the past 48 hours, with over a foot of new snow falling in the interior.*

*I am heading out of the Park tomorrow morning for the weekend and won't be able to visit Steamboat until early next week. Hopefully someone else who knows what to look at will get there before I do...*

*MK*

Email from Carolyn Loren on 22 February 2007, 14:53.

*Steamboat was seen having minor eruptions as usual at 1100 yesterday, 1/21, by Mike Breyers of Alpen Guides. At 1600 he could see a huge steam cloud as his coach was returning from Canyon towards Norris. Once there, they saw Cistern near empty and still dropping. The steam and noise were impressive at Steamboat.*

*He also noted that deep snow was still in place right up to Steamboat itself, and the blue ice around it was still intact also. He, Erica Hutchins and two Xanterra guides (who talked with Mary Wilson) said they did not note any debris in the area as they would expect after a Steamboat eruption.*

*One or both of the Xanterra guides said there were just 6 feet of water left in Cistern at 1600 on 1/21.*

*Carolyn Loren  
OFVC*

Yellowstone’s geologists downloaded temperature loggers and investigated Norris Geyser Basin on 23 February 2007.

**Observations**

On 23 February, Steamboat Geyser was only venting steam (Figure 1). No minor eruptions were occurring. Near Steamboat’s vents, snow and ice formations from past snow falls were visible (Figure 2). Snow and ice also covered the boardwalk across Steamboat’s channel, with no evidence of melting by increased water flow down Steamboat’s main runoff channel (Figure 3). Cistern was mostly empty, with a slight amount of muddy, frothing, water visible about 3 meters below the normal pool level (Figure 4)



**Figure 1.** Steamboat Geyser venting only steam.



**Figure 2.** Close up of Steamboat Geyser’s vent area. Notice the snow and ice still near its vent.



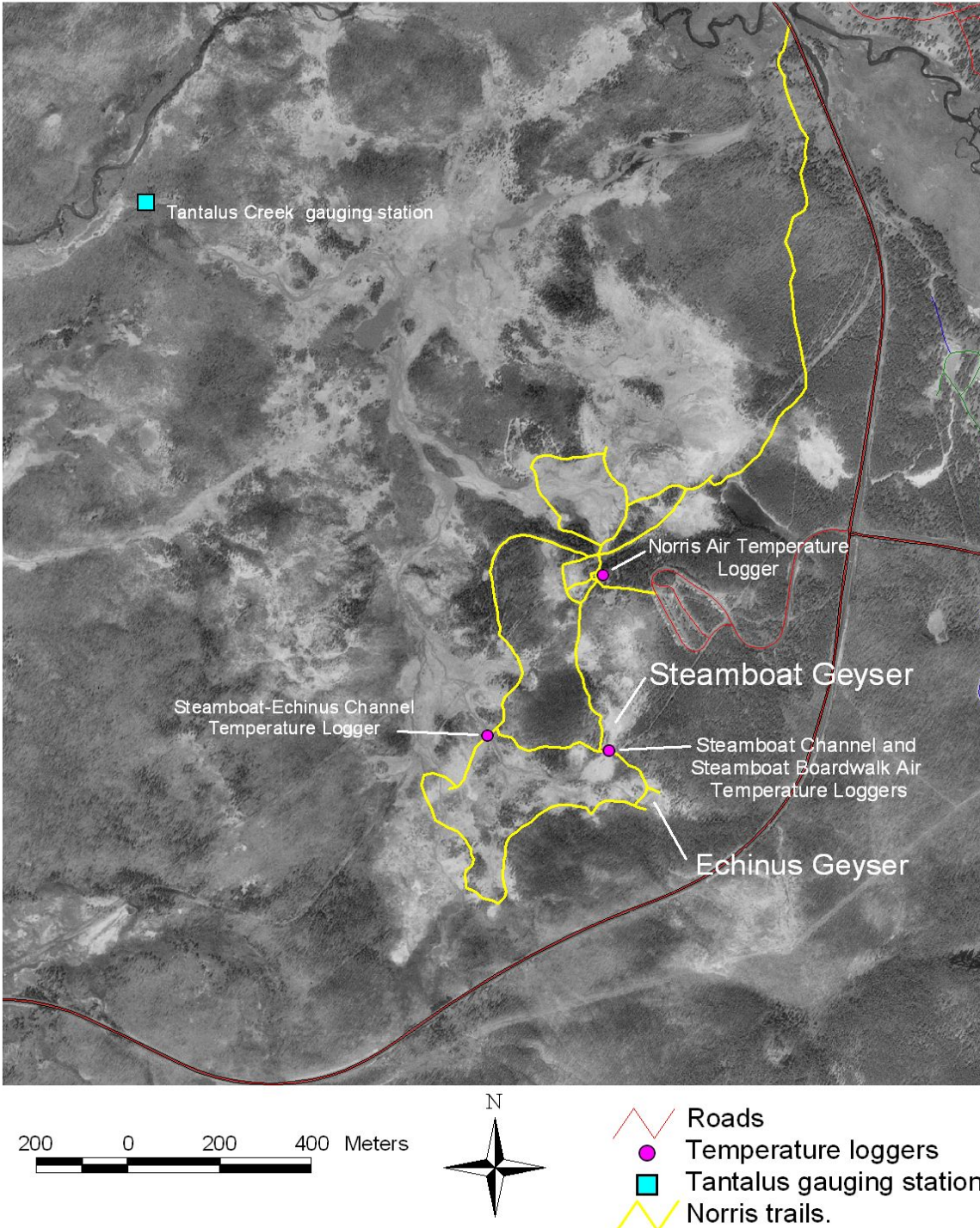
**Figure 3.** The boardwalk over Steamboat channel. Notice the snow and ice covering the boardwalk. Small rivulets of water upstream of the boardwalk show the extent of normal thermal erosion.



**Figure 4.** Cistern Spring was almost empty, with vigorously frothing, muddy, water about 3 meters below the normal water level.

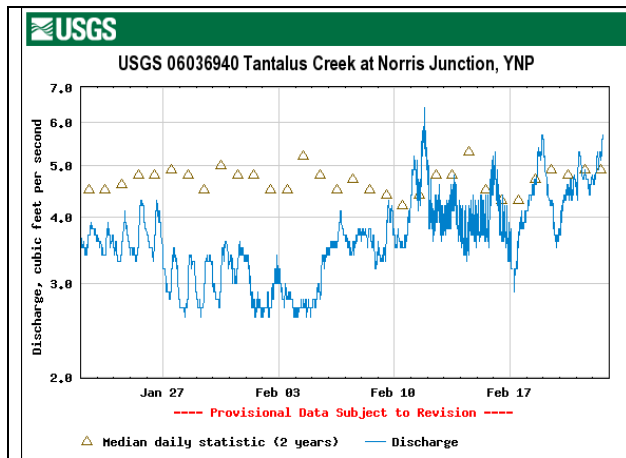
**Data**

Figure 5 shows the locations of the following stations: (1) the U. S. Geological Survey Tantalus Creek stream gauge station, (2) the air temperature station at the Norris Museum, (3) the air temperature station at the Steamboat boardwalk, (4) the temperature station at Steamboat channel, and (5) the temperature station at the Steamboat-Echinus channel.

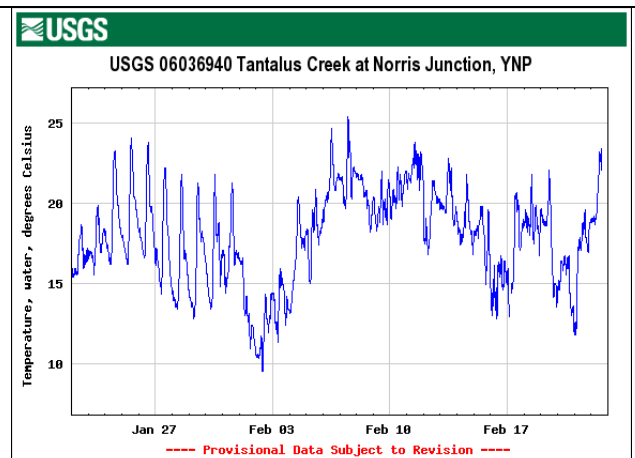


**Figure 5.** Black-and-white digital orthophotograph (1994) showing location of instrumentation within Norris Geyser Basin.

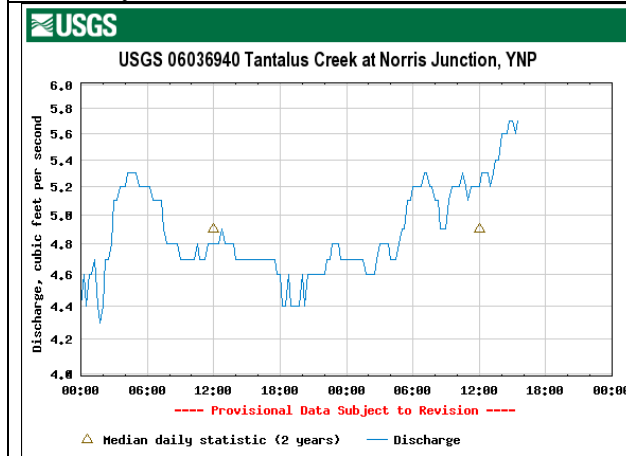
Discharge and temperature data from the Tantalus Creek stream gauging station are shown in Figures 6 through 9. The Tantalus Creek gauging station captures about 97% of the surface thermal water emanating from Norris Geyser Basin, including surface water flow from Steamboat Geyser. Figures 6 and 7 illustrate the variable amount of water flow from Norris Geyser Basin and variations in water temperature. Figures 8 and 9 cover the time period of the suggested eruption and show details of the discharge and temperature record.



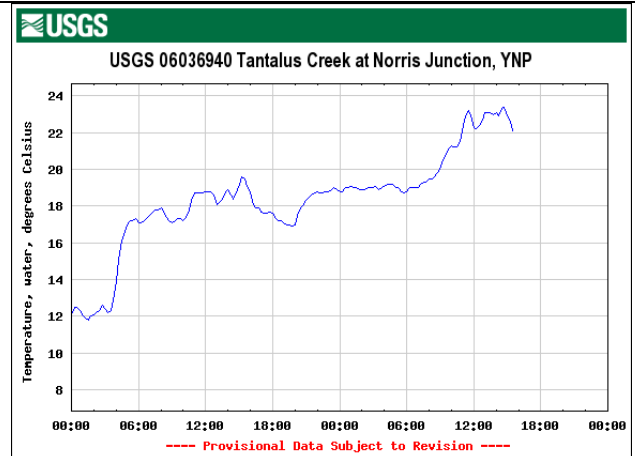
**Figure 6.** Discharge data from the Tantalus gauging station from 22 January to 22 February 2007.



**Figure 7.** Temperature data from the Tantalus gauging station from 22 January to 22 February 2007.

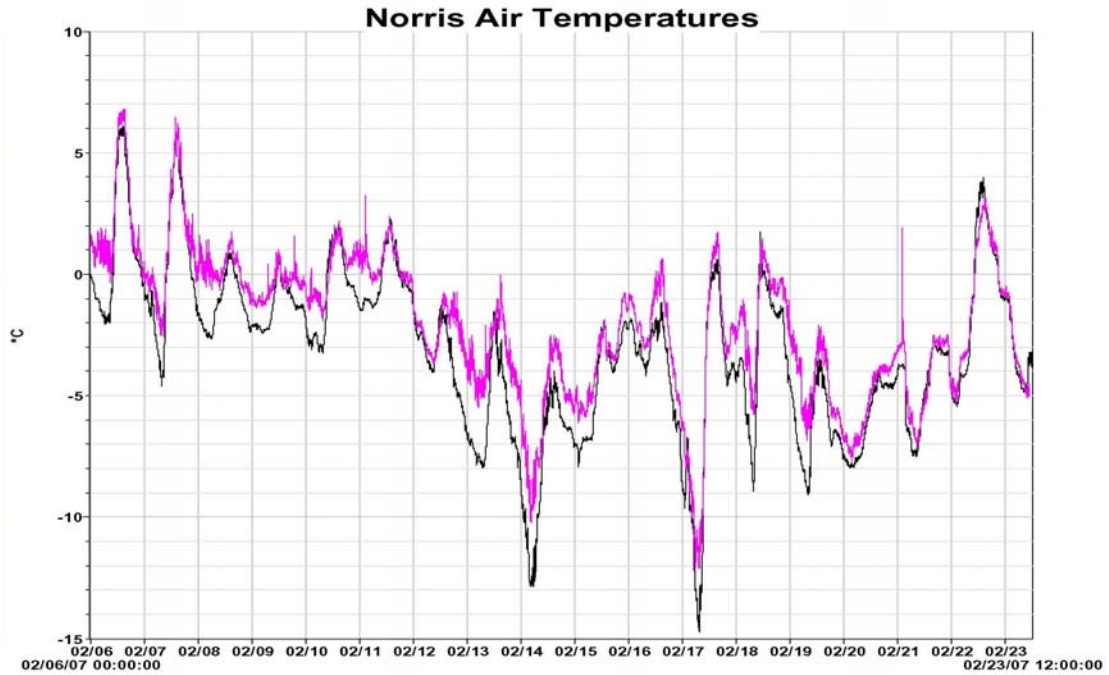


**Figure 8.** Discharge data from the Tantalus gauging station from 21 to 22 February 2007.

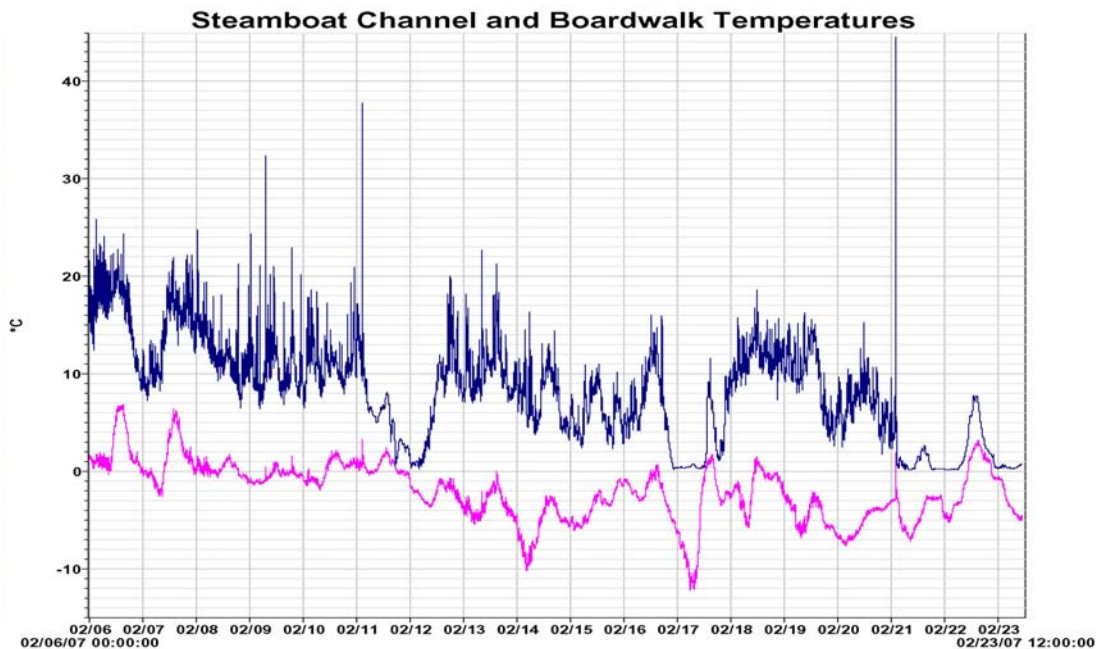


**Figure 9.** Temperature data from the Tantalus gauging station from 21 to 22 February 2007.

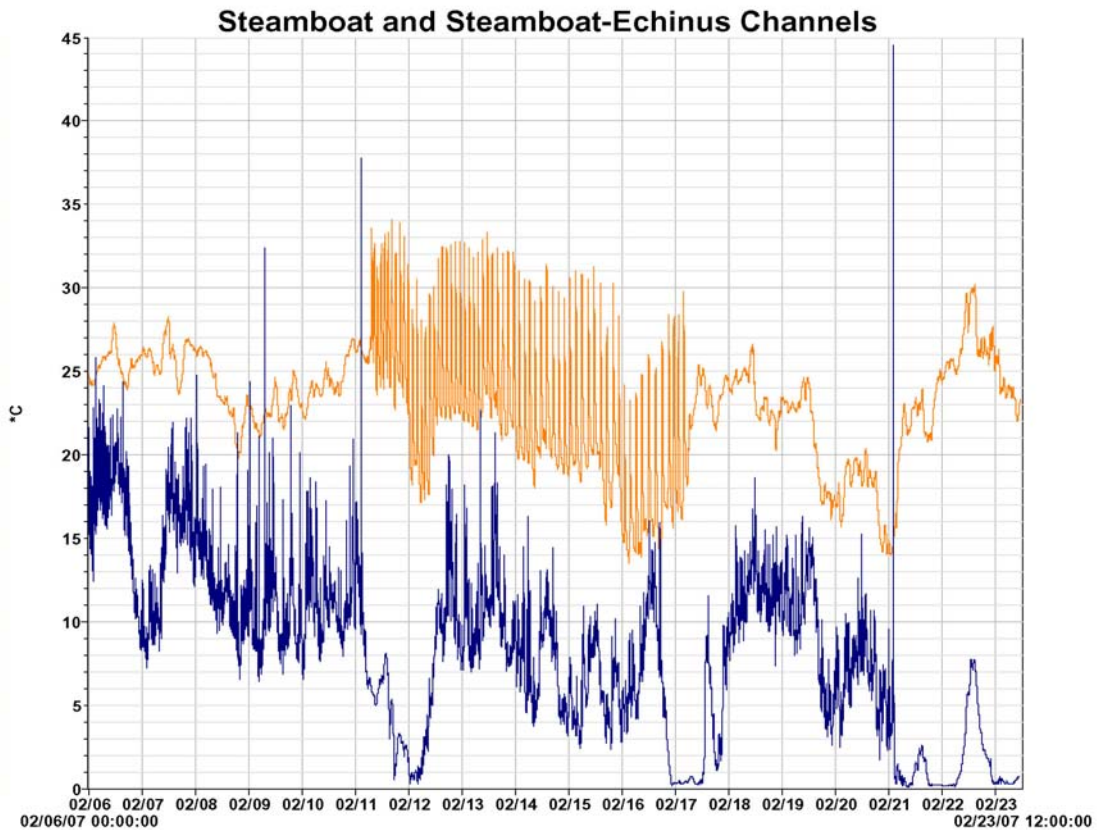
Figures 10, 11, and 12 show temperatures for four locations in Norris Geyser Basin (see Figure 5) from 6 February through 23 February 2007. Temperatures were logged every 2 minutes to a precision of 0.05 °C.



**Figure 10.** Graph showing comparison of temperature data (6 February through 23 February 2007) for the outside air temperature at the Norris museum (black line) and air temperature under the boardwalk at the Steamboat channel (purple line). See Figure 5 for locations.



**Figure 11.** Graph showing comparison of temperature data (6 February through 23 February 2007) for the outside air temperature under the boardwalk at the Steamboat channel (purple line) and the temperature in Steamboat's runoff channel (dark blue line) near the boardwalk shown in Figure 3. See Figure 5 for locations.



**Figure 12.** Graph showing comparison of temperature data (6 February through 23 February 2007) for the temperature in Steamboat’s runoff channel (dark blue line) and the Steamboat-Echinus runoff channel (orange line). Notice the periodic eruptions of Echinus from 11 February through 17 February 2007. See Figure 5 for locations.

### Discussion

A *major* eruption of Steamboat is defined as a *forceful water phase that erupts considerable water*. After such an eruption, Steamboat exhibits a forceful steam phase and Cistern usually drains. Indications of a major eruption also include the flowing of water and debris over the boardwalk covering Steamboat’s main runoff channel (Figure 3). During previously documented major eruptions of Steamboat Geyser in 2002, 2003, and 2005, the increased volume of erupted, hot water in the Steamboat runoff channel suddenly caused a temperature increase to 60 to 70 °C at the Steamboat channel logger and a rapid rise in air temperature to 45 to 70 °C at the Steamboat boardwalk logger. Increased water flow and temperature at the Tantalus Creek gauging station are generally noticeable about 45 minutes after a major eruption.

On 23 February 2007, Steamboat was no longer having minor eruptions; only a steam phase was observed (Figure 1). Figures 2 and 3 clearly show that Steamboat did *not* experience a significant water phase eruption as indicated by 1) the presence of ice and snow near Steamboat's vents and 2) the presence of undisturbed snow on the Steamboat channel boardwalk. At the Tantalus Creek gauging station, data also does *not* indicate a significant increase in stream discharge or temperature on 21 February 2007 (Figures 8 and 9).

Air temperatures at the Norris Museum and under the boardwalk at the Steamboat runoff channel generally track each other very closely (Figure 10). Notable exceptions occur on 11 and 21 February 2007. These deviations can be explained by relatively more forceful minor eruptions of Steamboat Geyser (Figure 11). As indicated by temperatures in the Steamboat runoff channel, Steamboat had forceful *minor* eruptions on 11 February at 2:40 a.m. MST (37.4 °C) and 21 February at 2:00 a.m. MST (44.5 °C). After both of these forceful minor eruptions, the water flow from Steamboat Geyser decreased greatly as indicated by the near 0 °C temperatures under the boardwalk along Steamboat's major runoff channel.

At the Steamboat-Echinus channel logger, temperature data also does *not* show a major discharge of hot water (Figure 12) associated with a major Steamboat water phase on 21 February 2007. From 11 February through 17 February 2007, the Steamboat-Echinus runoff channel clearly shows temperature increases associated with eruptions of Echinus Geyser from 11 through 17 February. However, no such temperature spikes are seen on 21 February.

Given the lack of supporting data for a significant water discharge from Steamboat Geyser on 21 February, a major eruption of Steamboat is not indicated.