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## Þríhnúkargígur\*

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The most northeasterly of the Þríhnúkar (Three Peaks) is a hollow volcanic cinder cone (Figure 1) that erupted in about the time of the settlement of Iceland (784 AD) (Jóhannesson and Sæmundsson, 1989). It is 36 meters high and stands on the highland edge about 20 kilometers southeast of Reykjavík, at an altitude of 550 meters. In the top of the cone is an opening—underneath is a tremendous volcanic chamber, side passages, and vent. On the southwest slope is a small crater that emitted a small flow of about 200 square meters to the south. Also to the southwest, 150 to 200 meters from the main vent, are four small craters that spewed a small lava flow of about one hectare to the east.

This was a small fissure eruption that soon centered itself in the cinder cone on the northeasterly part of the fissure. The lava covers about 38 hectares (94 acres) and is estimated to be five meters thick. It totals about two cubic hectares [*sic*] (Jónsson, 1978) and is rather small. The lava is rich with plagioclase dots and is easy to distinguish from the older Þríhnúkar lava that only has some small olivine dots (Jónsson, 1978; Einarsson). About one kilometer to the northeast are some craters in the same line that spewed forth a bigger lava, estimated at 200 hectares (495 acres) (Jónsson, 1978). This lava is also very plagioclase rich (Jónsson, 1978; Einarsson) and the eruption there may very well have taken place at the same time.

What makes the peak unique is the volcanic chamber and the volcanic vents that have emptied themselves without collapsing. The cinder cone, the tremendous chamber, and passages underneath are singular in their kind in the world for



Figure 1—The most northeast Þríhnúkar, a hollow volcanic cone.

their depth and size, so far as I know. (Note: I just recently learned of a bigger chamber on the Azores. It is not much bigger and not as deep. I am not quite sure which one is more voluminous.)

The opening in the top of the cone is four by four meters. The vertical drop to the bottom of the underlying chamber is 121 meters. The vent widens from four by four meters at the top to eight by 15 meters at 50 meters in depth. From 35 to 55 meters in depth is a narrow parallel side vent to the northeast (0.5 to 1.5 meters in diameter) which, in cross section, is shaped like the handle of a jug. At 60 meters depth the vent widens suddenly to the northeast and measures about 15 by 40 meters. Above the northeast end of the widening is a large chimney that is clearly connected with a crater bowl 10 meters northeast of the entrance opening. From 60 meters down is a tremendous chamber about 150,000 cubic meters in volume. The center of the chamber is 121 meters below the surface. The diameter at this point on the bottom is 48

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\*Poster exhibit, text from the *York Grotto Newsletter*, Vol 28 No 3, pp 45-51 © 1991.

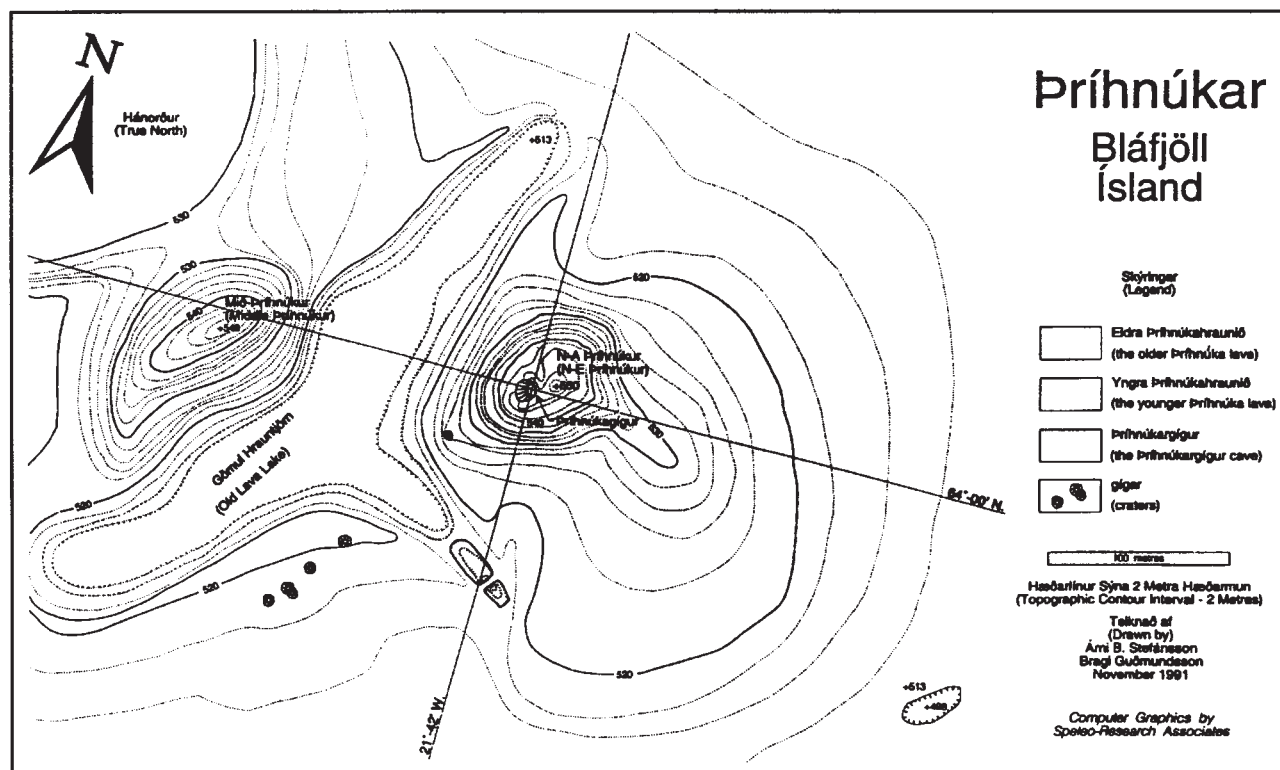


Figure 2—Topographic map of Þríhnúkar.



Figure 3—Ready to descend the 121-meter drop.

meters southeast to northwest and 65 meters southwest to northeast. Down to the southwest is a passage sloping  $50^\circ$  downward for 115 meters. The total depth of the vent is 204 meters. At 175 meters depth there is a chimney 45 meters high shaped like an elongated bulb. The lowermost diameter is 2.5 by 2.5 meters; the maximum diameter at 25 meters height is four by five meters. This vent seems to be the feeder of the small crater in the southwest slope of the main crater. The feeder chimneys for the craters 150 to 200 meters southwest of the main crater must be deeper than we were able to penetrate.

The original lava coat is on the walls from the surface down to minus 75 meters on the southeast and northwest walls, but tongues of lava coat extend down to minus 90 meters on the southwest and northeast walls. It looks about 40 to 50 centimeters thick at the edge where the lower part is broken off. This coat is, for the most part, a long-rippled matte gray glassy lava from the surface down to minus 50 to 60 meters. In and around the big chimney at minus 60 meters the walls are covered with frothy red lava sputter that has dripped down into an abundance of rather pretty little stalactites. The original lava coat is also on the walls of the chimney that rises from the southwest passage. At the broken lower edge it is 10

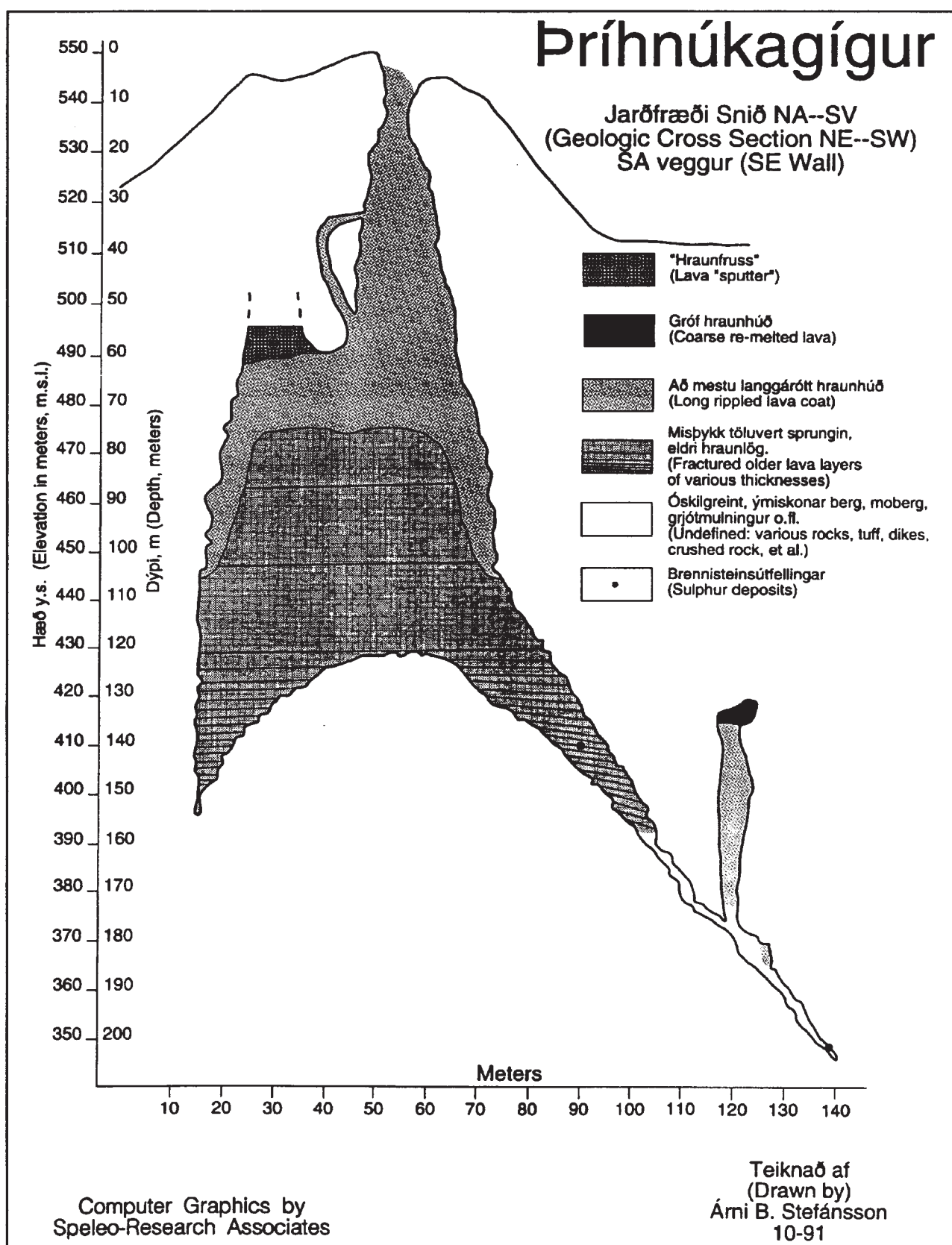


Figure 4— Geologic cross section of Þríhnúkagígur showing the southeast wall.



to 30 centimeters thick. The coat is similar to the coat in the main vent. At 40 meters in height in this chimney there is a circular sill. Above that the lava has a quite different, much coarser re-melted glassy appearance with yellow deposits. The sill is apparently the setting edge of the molten lava that must have stayed there for some time. It is probable that after the upper part of this vent closed the gas pressure from the gases emitted from the molten lava withheld this setting edge. Nowhere else was a setting edge to be seen.

This points to a continuous drainage of the lava down from the vent to a point deeper than we were able to penetrate, how quickly is hard to say. Lastly, there was some lava spatter on the southeast wall in the southwest passage at 185 to 190 meters depth—the same kind as found around the chimney at minus 60 meters.

The walls of the main chamber, from 75 to 125 meters depth, consist of three quite cracked old (probably the last interglacial period) lava layers 15 to 25 meters thick. No “in-between” layer could be seen, but the boundaries were fairly distinct. Between minus 125 and 150 meters there are also old lava layers, but much thinner (one meter at minus 125 meters and 5 to 10 centimeters at minus 140 meters). On the lowest part of the northwest wall is a thick (15- to 20-meter) lens of compressed volcanic ash thinning out down to the southwest and northeast, possibly the root of the most westerly *Príhnúkar* (tuff).

The bottom of the chamber is a saddle formed from rock breakdown from the walls. The breakdown is higher against the southeast and north-

west walls because the main collapse is from the long sides of the fissure and therefore higher on these walls, but lower to the southwest and northeast. The rock on the bottom and on the walls is colored with some hematite (brown-red-yellow). This indicates considerable heat in the chamber for some time and, from the look of the rock, the main collapse took place during this early phase. The rock contracts on cooling so the main collapse takes place during the cooling phase, like in most lava caves. On the driest place on the walls of the southwest passage at minus 145 meters and minus 200 meters depth, there were some small, one-centimeter-thick sulfur deposits. This is unusual for a lava cave and speaks for considerable dryness at these places.

The tongues of original lava coat down on the southwest and northeast walls of the main chamber are the convex ends of a fissure. This fissure was probably 10 to 15 meters wide and 60 meters long at minus 100 meters. In an originally narrow fissure the lava concentrated on this part. The subsequent wideness must be from the erosion of the long sides by the erupting lava. The main collapse is from the less stable long sides and therefore the circular form of the chamber. If we could try to imagine, from the size of the fissure with elongation down to the southwest, just how deep the original lava has sunk, it must be 300 meters or deeper.

That this was a fissure eruption is also confirmed by the fact that one can see the original dike on the northeast wall, from the bottom up to the lava coat tongue at minus 90 meters, and down

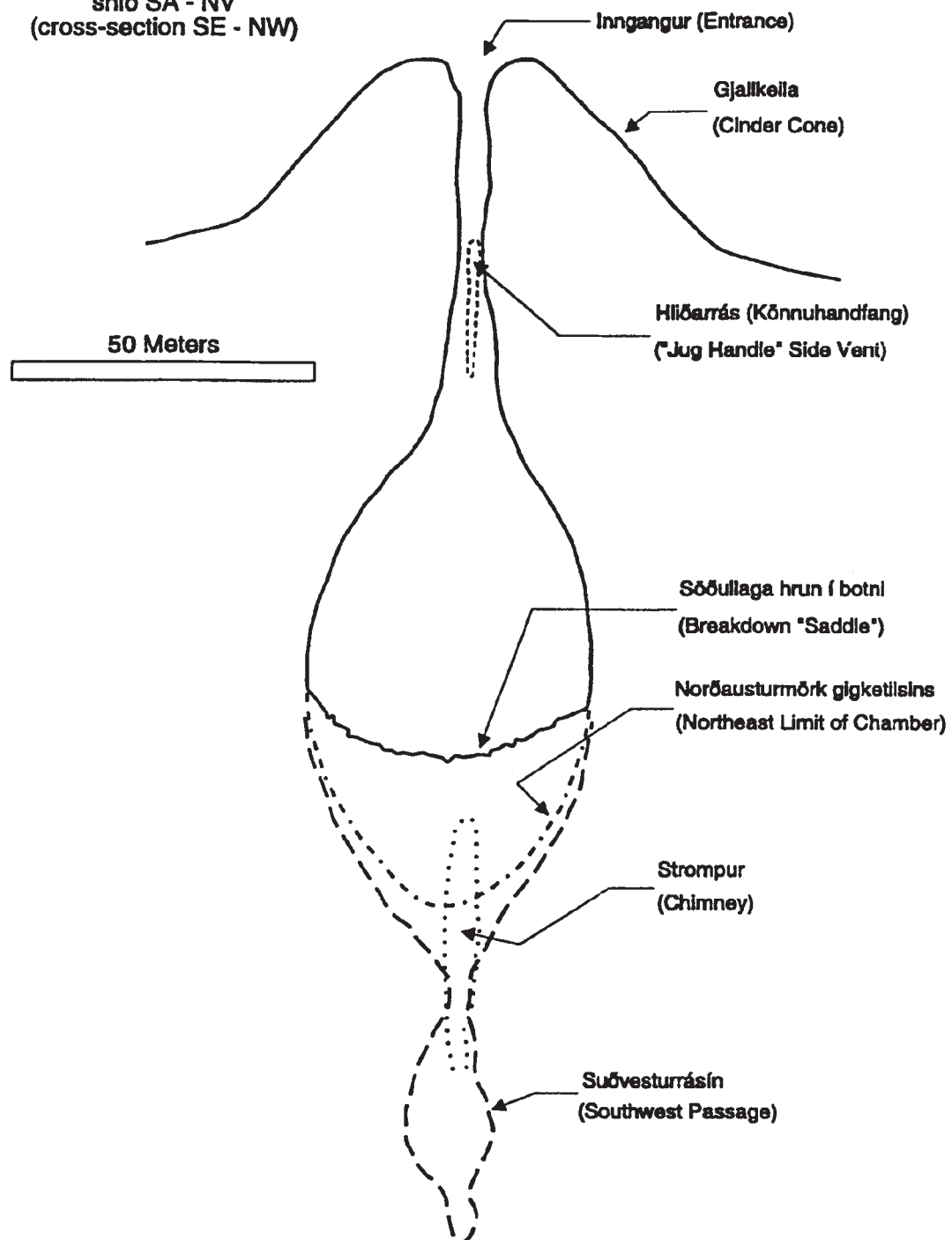
from the lava coat tongue on the southwest wall, in the ceiling of the southwest passage, in the southeast edge of the chimney at minus 175 meters, and continuing on in the ceiling of the southwest passage as far as we could go to the minus 204 meter depth, in all unbroken for about 190 meters. The direction of the fissure and all its formations is southwest to northeast like the main fissure system in Iceland.



Figure 5—Looking up the chimney.

# Þríhnúkagígur

snið SA - NV  
(cross-section SE - NW)



Computer Graphics by  
Speleo-Research Associates

Teiknað af  
(Drawn by)  
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10-91

Figure 6— Cross section of Þríhnúkagígur southeast to northwest.

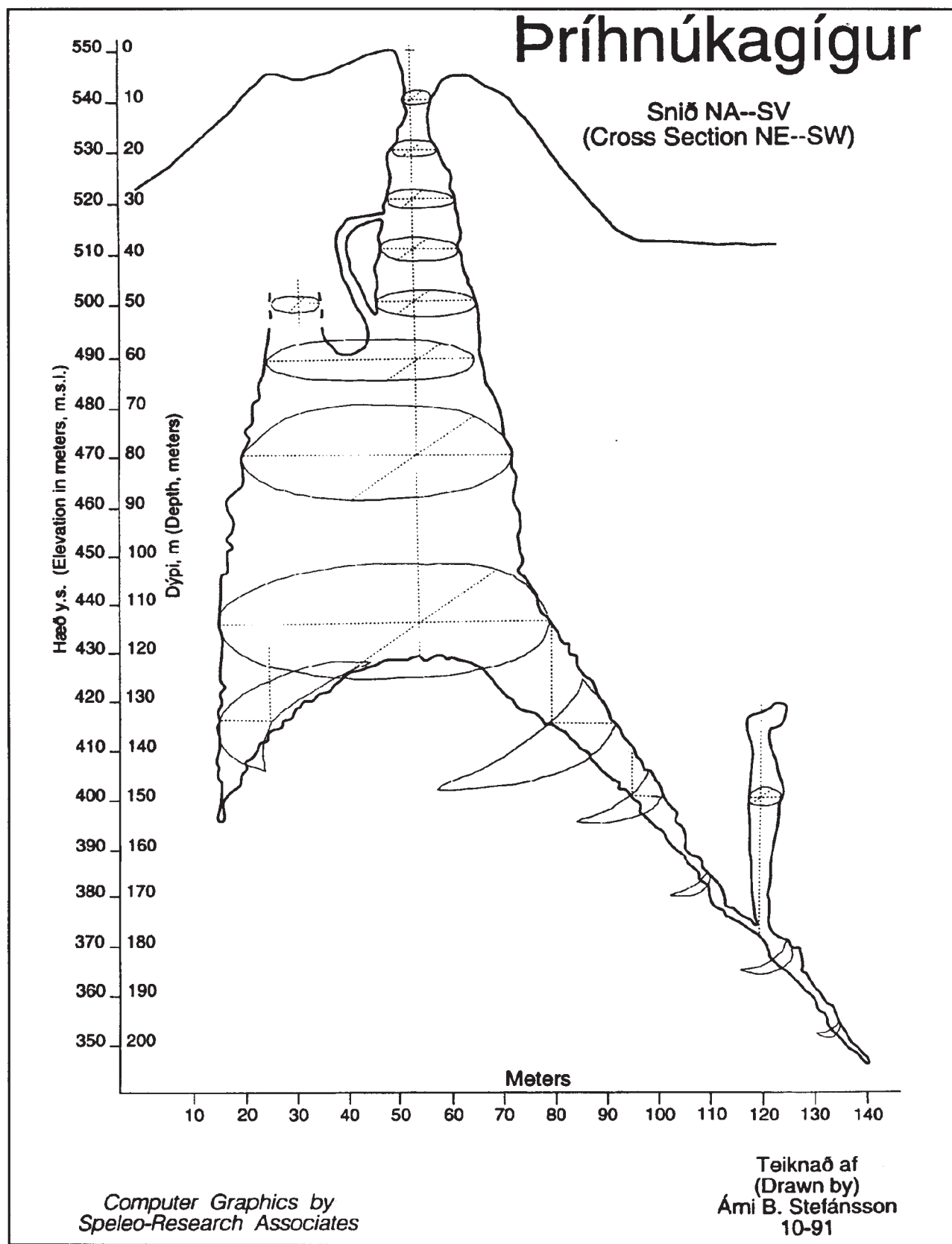


Figure 7— Cross section of Þríhnúkagígur northeast to southwest.

The surface temperature ranged from -10° to -3° Celsius. The temperature at the bottom of the big chamber was 4° Celsius and at minus 204 meters it was 5° Celsius. Temperature of ground water in these areas is 4.8° Celsius (Sæmundsson).

There was a slow northerly breeze, increasing during the day (April 6, 1991), and it was dry. The breeze pulled air from the vent, so conditions for photography were superb. Often it is quite humid and foggy down in the hole.

The measurements were made with compass, tape, clinometer, and a five-meter-long stick. It was a long way to the walls in the chamber and to the ceiling in the first part of the southwest passage, so there is some guesswork there. The depth of the chamber was plumbed with a nostretch nylon line that was subsequently measured with a tape. The total depth is probably within  $\pm$ two to three meters.

There is a lot of work behind these results. We would like to thank all of those who helped us and

the firms that supported us with equipment, Skátabúðin Reykjavík and Jóhann Rönning h/f Reykjavík (Hitachi Agency) and the rescue squads of Reykjavík and Kópavogur.

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