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Title	Repeated GPS measurements for detecting surface deformation of Okmok volcano, : Alaska. Data report
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Citation	Journal of the Faculty of Science, Hokkaido University. Series 7, Geophysics, 12(1), 55-61
Issue Date	2003-03-28
Doc URL	http://hdl.handle.net/2115/8873
Type	bulletin (article)
File Information	12(1)_p55-61.pdf

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Jour. Fac. Sci., Hokkaido Univ., Ser. VII (Geophysics), Vol. 12, No. 1, 55-61, 2003.

Repeated GPS Measurements for Detecting Surface Deformation of Okmok Volcano, Alaska : Data Report

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(Received January 8, 2003)

Abstract

We have carried out three GPS campaigns at Okmok volcano in 2000, 2001 and 2002. Okmok volcano has had an active history, the last eruption having occurred in 1997. Based on this fact, it was expected that the GPS measurements would detect the surface deformations caused by recent magmatic activities. Prior to the GPS measurements, InSAR measurements around Okmok indicated that the caldera had been inflating after 1997 eruption. We established and surveyed a dense GPS network with 33 stations on and around the Okmok caldera.

1. Introduction

Okmok volcano which is located on Umnak Island in the eastern part of Aleutian Arc is one of the most active volcanoes in the Aleutian Islands Arc (Fig. 1). More than 10 eruptions have occurred in the 20th century. Several significant surface deformations have been measured by InSAR technique (Lu et al., 1998, Lu et al., 2000, Mann et al., 2002), and the uplift inside the caldera was interpreted as inflation after the 1997 eruption. We adopted GPS technique to acquire another geodetic data set which is expected to supplement InSAR data. Futhermore GPS results would be a good check to those obtained by InSAR.

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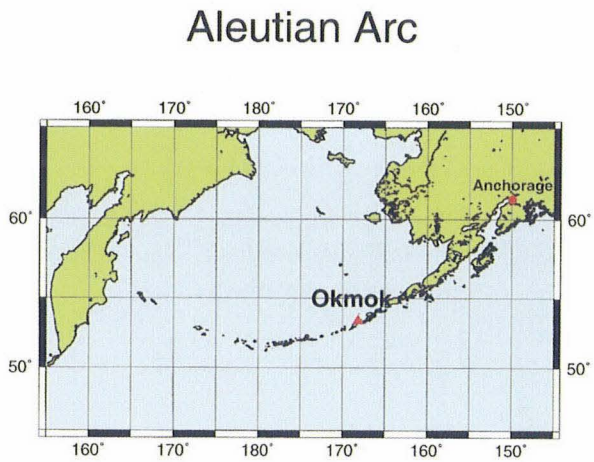

Fig. 1. Okmok is located on Umnak Island in the eastern Aleutian.

2. Observation and Analysis

In the observation, we mainly used dual frequency receivers (Trimble 4000SSI, 4000SSE, 5700), and tentatively used single frequency receivers (FURUNO MG-2110). The latter were installed in the area that was relatively close to the local reference station, in 2000 and 2001 (BRCT, NWFT, SHIP, WWFT). The GPS data were recorded at least one day in each site with 30 seconds sampling and 5 degrees of elevation mask. We processed the GPS data using Bernese GPS Software Ver. 4.2 with IGS precise orbit. In the first year of our campaigns, we determined the coordinates of "FTGL" as a local reference station on this island relative to closest IGS station "FAIR" in ITRF97 reference frame, which is located in Fairbanks about 1700 km from Okmok volcano. Having set the coordinates of FTGL as fixed, we determined the coordinates of other GPS stations relative to this local reference station in each year.

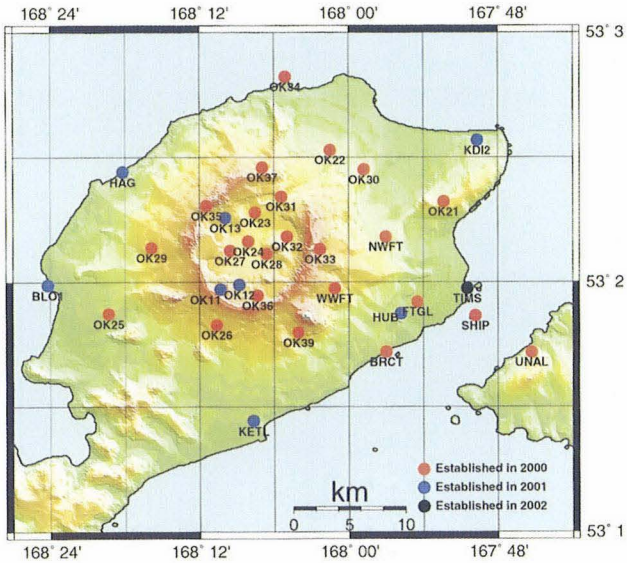

Fig. 2. GPS station map around Okmok volcano. Red circles represent the stations established in 2000. Blue circles represent the stations established in 2001. Black circle represents the station established in 2002. "FTGL" is the local reference station in this network.

3. Conclusion

A well-distributed GPS network composed of 33 sites on and around the Okmok caldera has been established shown in Fig. 2. So far we have also successfully carried out three GPS campaigns on Okmok volcano to detect surface deformations caused by magmatic activity. We set a local reference station on this island, and determined the coordinates of all GPS stations in each year (Table 1, Table 2, Table 3).

Table 1. Coordinates of GPS stations determined by 2000 data in ITRF97 reference frame. FTGL was determined relative to IGS station FAIR. Other stations were determined relative to FTGL.

	NAME:	LATITUDE(° ′ ″)	LONGITUDE(° ′ ″)	HEIGHT(m)
1.	FTGL:	53 23 3.634114	−167 54 29.300840	53.9759
2.	OK21:	53 27 52.733258	−167 52 22.326402	420.5854
3.	OK22:	53 30 22.037720	−168 1 30.370779	231.5746
4.	OK23:	53 27 21.288050	−168 7 32.071461	412.4711
5.	OK24:	53 25 57.571312	−168 8 5.611352	397.7754
6.	OK25:	53 22 28.362112	−168 19 19.549417	225.3817
7.	OK26:	53 21 56.349239	−168 10 37.902271	589.2213
8.	OK27:	53 25 30.254679	−168 9 32.562332	457.0688
9.	OK28:	53 25 21.398750	−168 6 36.382431	462.7819
10.	OK29:	53 25 39.215486	−168 15 52.490097	447.5424
11.	OK30:	53 29 25.512096	−167 58 47.211555	259.1679
12.	OK31:	53 28 7.357322	−168 5 25.474901	371.1465
13.	OK32:	53 26 12.246450	−168 4 58.937813	410.8378
14.	OK33:	53 25 35.855508	−168 2 19.403462	733.4078
15.	OK34:	53 33 52.640278	−168 5 6.737773	24.5721
16.	OK35:	53 27 40.263500	−168 11 26.081961	950.8354
17.	OK36:	53 23 21.378653	−168 7 21.160740	725.5427
18.	OK37:	53 29 31.462461	−168 6 57.629601	631.3547
19.	OK39:	53 21 34.512829	−168 4 4.626139	543.0406
20.	UNAL:	53 20 37.704346	−167 45 17.448360	201.5167
21.	BRCT:	53 20 39.265370	−167 57 0.210178	22.2969
22.	NWFT:	53 26 11.403290	−167 57 1.646612	323.0401
23.	SHIP:	53 22 23.425880	−167 49 49.628790	79.6996
24.	WWFT:	53 23 42.065190	−168 1 8.234940	534.2279

Table 2. Coordinates of GPS stations determined by 2001 data in ITRF97 reference frame. FTGL was fixed its coordinates to 2000 coordinates. Other stations were determined relative to FTGL.

	NAME:	LATITUDE(° ′ ″)	LONGITUDE(° ′ ″)	HEIGHT(m)
1.	FTGL:	(FIXED STATION TO 2000 COORDINATE)		
2.	OK21:	53 27 52.733562	-167 52 22.326315	420.5764
3.	OK22:	53 30 22.037750	-168 1 30.370630	231.5694
4.	OK23:	53 27 21.288584	-168 7 32.071188	412.4782
5.	OK24:	53 25 57.571712	-168 8 5.610668	397.7822
6.	OK25:	53 22 28.362268	-168 19 19.549336	225.3468
7.	OK26:	53 21 56.349505	-168 10 37.902478	589.2233
8.	OK27:	53 25 30.254978	-168 9 32.563254	457.0817
9.	OK28:	53 25 21.398573	-168 6 36.381563	462.7871
10.	OK29:	53 25 39.215978	-168 15 52.490299	447.5244
11.	OK30:	53 29 25.512384	-167 58 47.211537	259.1700
12.	OK31:	53 28 7.357784	-168 5 25.474970	371.1258
13.	OK32:	53 26 12.246683	-168 4 58.936952	410.8364
14.	OK33:	53 25 35.855629	-168 2 19.403030	733.3978
15.	OK34:	53 33 52.640701	-168 5 6.738156	24.5552
16.	OK35:	53 27 40.263920	-168 11 26.082269	950.8386
17.	OK36:	53 23 21.378477	-168 7 21.160797	726.0070
18.	OK37:	53 29 31.462951	-168 6 57.629727	631.3113
19.	OK39:	53 21 34.513091	-168 4 4.626361	543.0409
20.	UNAL:	53 20 37.704532	-167 45 17.448128	201.4993
21.	BRCT:	53 20 39.265428	-167 57 0.210076	21.5222
22.	NWFT:	53 26 11.403530	-167 57 1.646680	322.4273
23.	SHIP:	53 22 23.425673	-167 49 49.628295	78.3706
24.	WWFT:	53 23 42.065152	-168 1 8.234760	533.1945
25.	BLOW:	53 23 51.451093	-168 24 11.264439	30.6393
26.	HAG :	53 29 18.054211	-168 18 11.128045	21.4513
27.	HUB :	53 22 29.305878	-167 55 49.897685	144.8017
28.	KDI2:	53 30 49.363530	-167 49 40.056855	165.5036
29.	KETL:	53 17 18.906946	-168 7 42.268271	142.5150
30.	OK11:	53 23 38.477806	-168 10 17.960443	775.7992
31.	OK12:	53 23 52.298119	-168 8 48.647887	616.4394
32.	OK13:	53 27 5.664536	-168 9 56.609947	498.5251

Table 3. Coordinates of GPS stations determined by 2002 data in ITRF97 reference frame. FTGL was fixed its coordinates to 2000 coordinates. Other stations were determined relative to FTGL.

	NAME:	LATITUDE(° ′ ″)	LONGITUDE(° ′ ″)	HEIGHT(m)
1.	FTGL:	(FIXED STATION TO 2000 COORDINATE)		
2.	OK21:	53 27 52.733651	-167 52 22.326388	420.5808
3.	OK22:	53 30 22.037796	-168 1 30.370662	231.5711
4.	OK23:	53 27 21.289497	-168 7 32.071085	412.5274
5.	OK24:	53 25 57.572221	-168 8 5.611439	397.8669
6.	OK25:	53 22 28.362264	-168 19 19.549546	225.3785
7.	OK26:	53 21 56.349218	-168 10 37.902715	589.2338
8.	OK27:	53 25 30.254859	-168 9 32.564906	457.1396
9.	OK28:	53 25 21.398362	-168 6 36.379700	462.8492
10.	OK29:	53 25 39.215827	-168 15 52.491014	447.5331
11.	OK30:	53 29 25.512332	-167 58 47.211591	259.1645
12.	OK31:	53 28 7.358098	-168 5 25.474427	371.1448
13.	OK32:	53 26 12.246748	-168 4 58.935446	410.8603
14.	OK33:	53 25 35.855540	-168 2 19.402388	733.4125
15.	OK34:	53 33 52.640613	-168 5 6.738029	24.5541
16.	OK35:	53 27 40.264299	-168 11 26.083155	950.8447
17.	OK36:	53 23 21.377649	-168 7 21.160521	726.0251
18.	OK37:	53 29 31.463196	-168 6 57.629731	631.3402
19.	OK39:	53 21 34.513005	-168 4 4.626187	543.0340
20.	UNAL:	53 20 37.704316	-167 45 17.448397	201.5040
21.	BRCT:	53 20 39.265353	-167 57 0.210305	21.5349
22.	NWFT:	53 26 11.403518	-167 57 1.646579	322.4334
23.	SHIP:	53 22 23.425743	-167 49 49.628656	78.3736
24.	WWFT:	53 23 42.064897	-168 1 8.234538	533.1830
25.	BLOW:	53 23 51.451078	-168 24 11.264645	30.6400
26.	HAG :	53 29 18.054327	-168 18 11.128411	21.4716
27.	HUB :	53 22 29.305777	-167 55 49.897856	144.8290
28.	KDI2:	53 30 49.363360	-167 49 40.056733	165.5134
29.	KETL:	53 17 18.906835	-168 7 42.268263	142.5283
30.	OK11:	53 23 38.476779	-168 10 17.961457	775.8133
31.	OK12:	53 23 52.296912	-168 8 48.648772	616.4651
32.	OK13:	53 27 5.665269	-168 9 56.611103	498.5549
33.	TIMS:	53 23 41.863859	-167 50 27.926316	18.7296

Acknowledgement

Part of this study is supported by the National Space Development Agency of Japan (NASDA) through the projects of Arctic Research projects using IARC (International Arctic Research Center)-NASDA Information System (INIS) and Satellite Data. And logistical support was provided by the Alaska Volcano Observatory.

Taking this opportunity, I appreciate all the help and support of the concerned research institutes, including UAF and IARC.

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