AD-A273 472

IENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
		ANNUAL - 1 Jun 89 - 31 Dec 90

4. TITLE AND SUBTITLE
CRUSTAL DEFORMATION MEASUREMENTS IN THE VICINITY OF VANDENBERG AIR FORCE BASE

5. FUNDING NUMBERS
AFOSR-89-0400
61102F
2309
AS

(2)

6. AUTHOR(S)
Dr Robert W. King

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Earth Atmospheric & Planetary Sciences
Massachusetts Institute of Technology
Cambride MA 02139

8. PERFORMING ORGANIZATION REPORT NUMBER
AFOSR-JR-

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFOSR/NL
110 Duncan Avenue, Suite B115
Bolling AFB DC 20332-0001
Dr Dickinson

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release;
distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Recent geological and geodetic studies have suggested that the region surrounding Vandenberg AFB, CA is undergoing active crustal deformation. In 1989 funding under this grant was used to purchase five GPS receivers and to begin a series of measurements designed to determine the magnitude and spatial distribution of deformation in a region encompassing the major faults and folds within 50 km of Vandenberg. Four receivers were acquired in January 1990 and experiments were performed in February and September. The fifth receiver will be sited near the former NASA Very Long Baseline site and will become integrated into the Permanent GPS Geodetic Array in California.

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
(U)	(U)	(U)	(UL)

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements***.

Block 1. Agency Use Only *(Leave blank)*.

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C	- Contract	**PR**	- Project
G	- Grant	**TA**	- Task
PE	- Program Element	**WU**	- Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. *(If known)*

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denote public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD	See DoDD 5230.24, "Distribution Statements on Technical Documents."
DOE	See authorities.
NASA	See Handbook NHB 2200.2.
NTIS	Leave blank.

Block 12b. Distribution Code.

DOD	- Leave blank.
DOE	- Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
NASA	- Leave blank.
NTIS	- Leave blank.

Block 13. Abstract. Include a brief *(Maximum 200 words)* factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code *(NTIS only)*.

Blocks 17. - 19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

80 1,

Crustal Deformation Measurements in the Vicinity of Vandenberg Air Force Base

Grant AFOSR-89-0400
(MIT OSP No. 72373)

Annual Technical Report

for the period

1 June 1989 - 31 December 1990

Submitted to

Air Force Office of Scientific Research

James F. Lewkowicz
Program Manager
PL/LWH Hanscom AFB MA 01731-5000

Capt Helen R. Tyson
Contracting Officer
AFOSR/PKZA
Bolling AFB, DC 20332-6448

by

Robert W. King
Principal Investigator
Department of Earth, Atmospheric, and Planetary Sciences
Massachusetts Institute of Technology
Cambridge, MA 02139

30 September 1991

BACKGROUND AND OBJECTIVES

Recent geological and geodetic studies have suggested that the region surrounding Vandenberg AFB is undergoing active crustal deformation, with important implications for both the geodetic stability and the seismogenic potential of the Western Test Range (WTR). We have described these studies in a paper (*Feigl et al.*, 1990) published in the *Journal of Geophysical Research* and attached to this Interim Report. Part of the evidence for significant deformation was obtained from GPS measurements which we carried out in cooperation with other university and government scientists beginning in late 1986. These measurements have been made annually over a broad region of central and southern California but are of insufficient spatial and temporal density to answer many important questions about the seismogenic potential of Vandenberg.

In 1989 we received funding under this grant (with matching funds from MIT) to purchase five GPS receivers and to begin a series of measurements designed to determine the magnitude and spatial distribution of deformation in a region encompassing the major faults and folds within 50 km of Vandenberg. We acquired four of the receivers in January 1990 and carried out two-week experiments in February and September. The fifth receiver is to be installed and operated continuously at the site of a new, highly stable geodetic monument near the former NASA VLBI site on south base. It will become part of the Permanent GPS Geodetic Array (PGGA) in California, providing a stronger tie of Vandenberg to the regional VLBI and GPS network and also a potential opportunity to detect any small transient motion which might occur at Vandenberg.

MEASUREMENTS PERFORMED IN 1990

The stations occupied in our experiments of February and September, 1990, are shown in Figure 1. The first of these experiments was designed to test our new receivers, to remeasure four sites (VNDN, LOSP, GRAS, and GAVI) first observed in 1987 and 1989, and to add three additional sites (ALAM, ALVA, and RUS1) to the network. Measurements to ALVA and RUS1, both within 5 km of the Vandenberg VLBI site, should detect any seaward sliding of the alluvium underlying the VLBI site. During the September experiment we reoccupied all eight of the previously established sites in the network and added one additional site (LIND) in a region where it had been difficult to find a monument which is in stable terrain and not close to radio antennas that might intervere with GPS observations.

DEVELOPMENT OF THE PGGA STATION

Between late 1989 and early 1991 we carried out an extensive series of discussions with responsible officials at Vandenberg concerning the siting and installation of the Permanent GPS Geodetic Array (PGGA) station on south base. It is important that the site be 1) geologically stable, 2) close to existing power and communications lines, 3) free from obstructions and radio-frequency interference, 4) not in an area where its installation would have an adverse environmental impact. In October 1989 we met on base with SAC and WTR officials responsible for radio-frequency control, civil engineering, and environmental affairs, and with representatives from NASA and the DMA Geodetic Survey Group, our primary liason for GPS work. At the same time we conducted a reconnaissance survey of four possible sites. This meeting and survey narrowed our choice to the vicinity of the VLBI site, and in January 1990 we submitted a formal request through USAF channels for an upgrade of the VLBI facility to include the new GPS station. Our original choice of a site was found to be in an area known to have archeological artifacts, so we shifted our interest to a new area several hundred meters away. In order to assess the geological stability of the new area, in September 1990 we supervised the drilling of five test holes from which we have now selected a site for the station. In 1991 we plan to construct at the site a high-stability geodetic monument of the type designed by Dr. Frank Wyatt of Scripps for the other stations of the PGGA. In order to take advantage of forthcoming improvements in GPS receiver design, we have delayed our purchase of a receiver for the PGGA station until the new models are available. These models promise higher efficiency in the measurements, probably at lower cost.

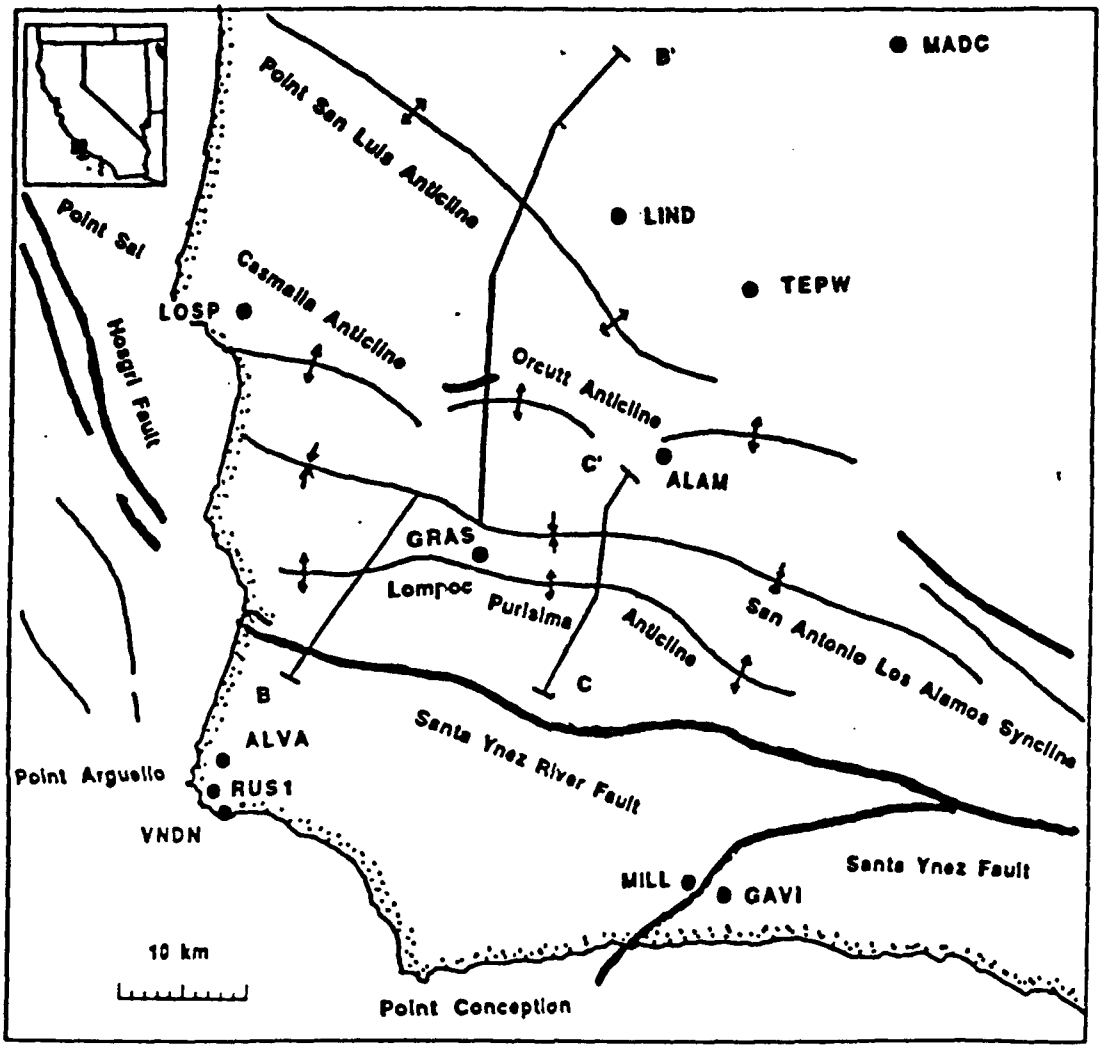

Figure 1. Tectonic map of Vandenberg and vicinity (Santa Maria Fold and Thrust Belt) showing the location of faults (thick lines) and folds (thin lines) and of the GPS stations (black dots with 4-letter codes) included in our study.