

EARTHQUAKE SWARM ACTIVITY AROUND VILLAGE BAMHORI, SEONI DISTRICT, MADHYA PRADESH: A PRELIMINARY STUDY

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Bamhori village in the Seoni district of Madhya Pradesh has been experiencing tremors at irregular intervals since February 2000. People of this and a few surrounding villages felt nearly 350 tremors between February and May 2000. The tremors of April 16 and May 28, 2000 were widely felt and created great deal more panic than usual. The recurrence of numerous tremors of low magnitude, often accompanied by acoustic emissions, confined within a small area shows that the earthquake activity is of swarm type. Since some of the major earthquakes in the Deccan Volcanic Province were preceded by swarm type activity, the Bamhori swarm warrants monitoring and detailed analysis.

Introduction

Earthquake swarms are sequences of tremors felt, localized over a small area and limited within a short time span, often accompanied by acoustic emissions. In peninsular India, seismic swarm activity has been observed at nearly 30 places (Srivastava and Dubey, 1996). Among these, the swarms at Latur and Koyna were followed by major earthquakes. In this background, systematic monitoring and analysis of swarms acquires significance (Rastogi, 1992).

Some villages surrounding Bamhori in the Dhanora Block of Seoni district in southern Madhya Pradesh have been experiencing tremors since February 2000. The number of tremors increased between February and May 2000, at times upto 4-5 felt tremors in a day, causing panic among the local population. Since May 2000, the frequency of felt tremors has decreased to a few events in a month. These events were not recorded in the nearest permanent seismic observatories, located at Jabalpur and Nagpur. This note, therefore presents the salient observations made during the field investigations on the seismic swarm activity around Bamhori.

Tectonic Setup

Bamhori is located about 70 km northeast of Seoni

within the Central Indian Tectonic Zone (CITZ), the Proterozoic mobile belt between the Bundelkhand and Bastar cratons (Acharyya and Roy, 2000) with attendant ductile shear zones and faults. The rocks exposed within the swarm area belong to the cover sequence of Deccan Traps (Fig.1). The Traps exposed in this area have been grouped under the Dhuma Formation (GSI, 1999) consisting of eight basalt flows. The Dhuma Formation is underlain by Mandla Formation, which represents the lower most formation of Deccan Traps in this area and consists of four basaltic flows. Gneisses, migmatites and granites of Precambrian age occur farther south of the study area. A major shear zone, passes in the vicinity of gneiss-Deccan Trap contact along ENE-WSW direction, south of the present area and is known as the Tan shear zone. The regional lineament map (Rajurkaretal. 1983) shows mostly ENE-WSW trending and rarely NNW-SSE trending lineaments (Fig.2). The Bouguer gravity map shows a gravity high between north of Seoni and west of Mandla.

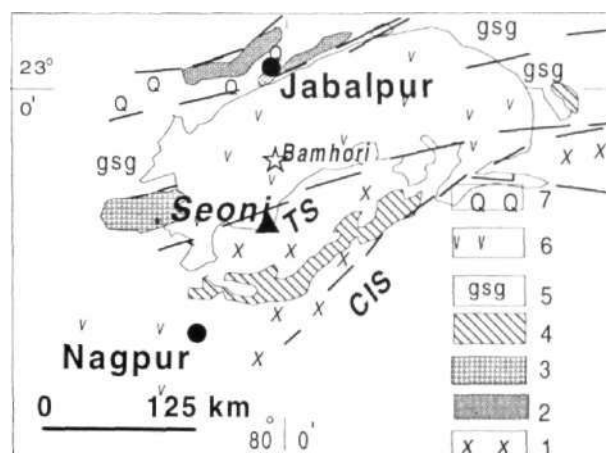


Fig.1. Geological map of a part of Central India showing the location of Bamhori (modified from published maps of GSI). 1 - Gneisses and migmatites, 2 - Mahakoshal Group, 3 - Betul belt, 4 - Sausar Group, 5 - Gondwana Supergroup, 6 - Deccan traps, 7 - Quaternary, CIS - Central Indian Shear Zone, TS - Tan Shear Zone.

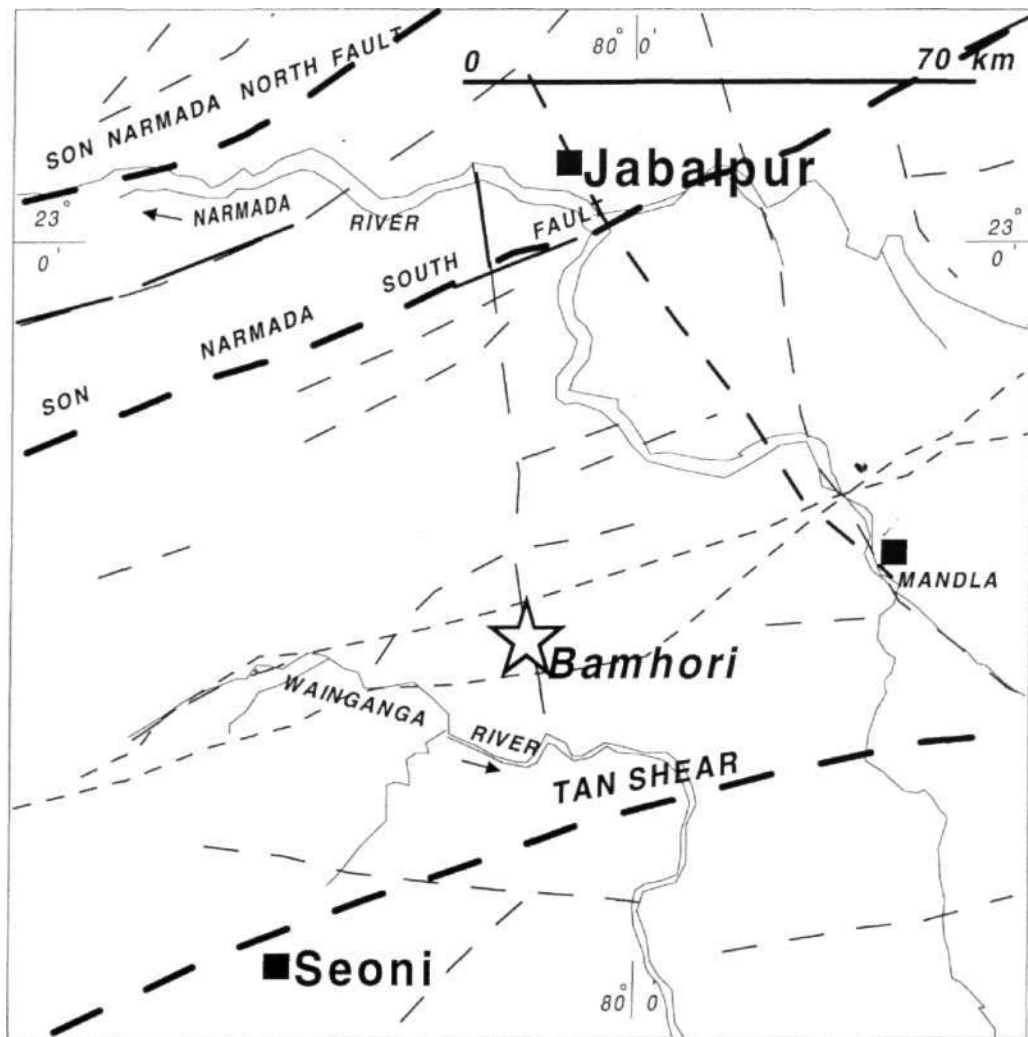


Fig.2. Lineament map of the Seoni-Jabalpur area (modified after Rajurkar et al. 1983)

The CITZ has witnessed more than 15 low to moderate earthquakes in the past (Table 1).

NATURE OF THE SEISMIC SWARM

Macroseismic surveys were carried out in the swarm affected villages using the guidelines suggested by GSI (Narula et al. 1996). The GSI method recommends the MSK-64 Intensity scale with adaptations from EMS-92 scale of the European Seismological Commission in the Indian conditions. The EMS-92 Intensity scale has since then been succeeded by the EMS-98 scale (Grunthal, 1998).

Bamhori

This village has about 100 houses. About 25 houses are built using bricks with mud mortar and mud plaster. Nearly 25 houses have walls of bricks, mud mortar and have cement

plaster. The roofs are of handmade tiles. These houses fall under the seismic vulnerability class Type-A of European Macroseismic Scale-98 (Grunthal, 1998). Four houses have brick walls, cement mortar, cement plaster and concrete roof. These houses fall under the Type-B.

The tremor of April 16, 2000 (at approximately 05.50 hrs, 1ST) was felt intensely by the villagers. People woke up and many ran outdoors. Roofs vibrated and a few roof tiles fell down from the edges. Sound similar to that of blasting was heard by all from a near source for a very brief duration. Nobody lost balance nor fell down. Hanging objects fixed to the wall swung but did not fall down. The ground shaking as well as vibrations did not last long. Cattle stood up but did not try to run away. No cracks developed in any of the houses. Chains attached to doors vibrated. These observations suggest intensity more than IV in MSK-64 scale.

Table 1. Earthquakes in Central Indian Tectonic Zone

Sl.No.	Date	Location	Lat. (N)	Long.(E)	Mag.	Source
1	27.05.1846	SE of Jabalpur	23.0°	80.0°	5.0(Ms)	USGS
2	1883	SSE of Chhindwara	21.5°	79.0°	2.3 (Ms)	USGS
3	17.05.1903	SE of Jabalpur	23.0°	80.0°	5.0(Ms)	USGS
4	02.06.1927	Umaria	23.05°	81.0°	6.5 Mb	USGS
5	25.08.1957	Balaghat	22.0°	80.0°	5.5 (Mb)	USGS
6	17.10.1957	SSE of Chhindwara	21.5°	79.0°		USGS
7	14.11.1968	Betul	21.8°	78.0°	4.2(Ms)	USGS
8	26.03.1969	Itarsi	22.6°	77.8°	4.2(MI)	USGS
9	12.07.1973	Narsinghpur	23.1°	79.0°	3.7(Ms)	USGS
10	13.08.1975	Betul	21.8°	77.7°	4.1 (Ms)	USGS
11	18.04.1987	Mandla	22.34°	79.26°	4.9(Mb)	USGS
12	31.10.1993	Niwas	23.0°	80.0°	3.7(Ms)	IMD
13	22.05.1997	Jabalpur	23.1°	80.1°	6.0(Ms)	IMD
14	23.11.1997	NE of Balaghat	22.2°	80.1°	3.7(Ms)	IMD
15	17.10.2000	SE of Jabalpur	80.2°	23.1°	5.2	IMD
16	23.01.2001	Jabalpur	79.98°	23.18°	3.7	GS1

Bhaliwara

This village is located about 2 km south of Bamhori (Fig.3). There are about 40-45 houses in this village. Only two houses have bricks with cement mortar, cement plaster and concrete roof (Type-B). All other houses have walls with brick, mud mortar, mud plaster and tiled roof or mud walls and tiled roofs (Type-A). The tremors of April 16th and 28th May were felt by most villagers. Persons sitting outside houses felt the ground shaking but did not lose composure. Roof tiles slightly shook. On 28th May 2000, (approximately 06.30 hrs IST) persons sleeping inside their

houses woke up and sat down but did not try to run outside. Roof tiles shook mildly. These observations suggest intensity more than IV in MSK-64 scale for the maximum felt event.

Bagahai

This village is about 3 km southeast of Bamhori and has about 101 houses. Except the school building, all other houses are constructed with either brick with mud mortar and mud plaster or with mud walls. Roofs are of handmade tiles. The tremor of 16th April 2000 was widely felt by the

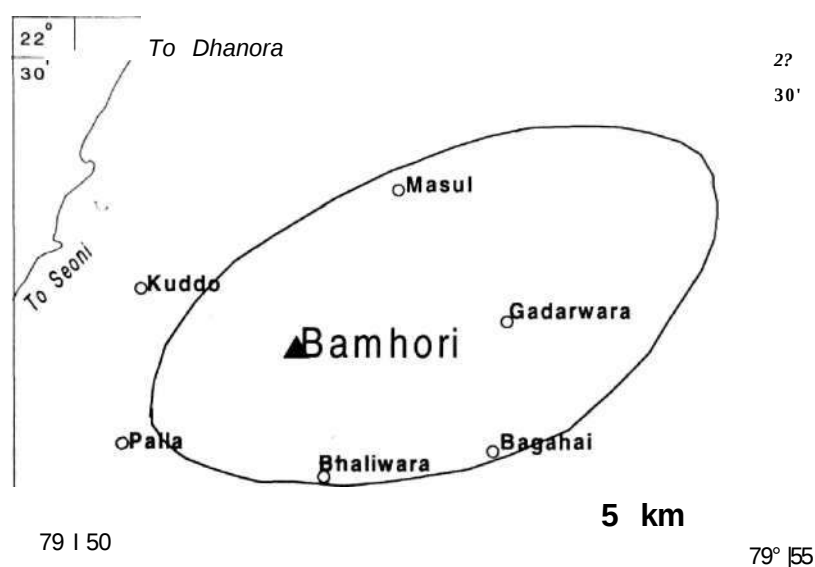


Fig.3. Map showing outline of the swarm affected area around Bamhori.

villagers. Most sleeping people woke up but did not come out from their houses. They also heard blasting like sound. Roof tiles shook but did not fall down. Loose mud plaster fell down in a single house. Intensity assigned is >IV.

Gadarwara

This village is located 3 km ENE of Bamhori. This village has about 40 - 45 houses. Two houses, including the village school have concrete roof. Remaining houses have brick walls with mud mortar, mud plaster or mud walls. Roofs are of hand made tiles. Most people felt the April 16th tremor. Most sleeping persons woke up but remained inside their houses. Vibrations of doors were felt. Roof tiles shook vigorously. A few fell down. No cracks were developed. Animals stood up but did try to run. A part of an old mud wall collapsed in a single house.

A southerly flowing stream on the western part of the village which had become dry during the summer months developed a new spring immediately after one of the major tremors. This is the only hydrological change reported within the affected area. These evidences are indicative of intensity more than V in the MSK-64 scale for this area.

Masul

This village is located 2 km to north east of Bamhori and has nearly 80 - 90 houses. Except the school building, all other houses are constructed with brick-mud mortar, mud plaster and roofs of handmade tiles. The tremor of 16th April, 2000 was widely felt in this village. Persons sleeping on cots inside houses woke up and ran outside. Roof tiles vibrated vigorously and a few fell down. Most people sleeping outside the houses woke up. Shaking was not strong enough to loose composure. Cracks were not developed in any of the houses. These observations also suggest that the intensity of the maximum felt events were more than IV in this village.

Inquiries made in the village Kuddo and Palla, which are located at about 2 and 3 km towards WNW and SW of Bamhori, respectively, revealed that the inhabitants villages did not feel any of the tremors.

DISCUSSION AND CONCLUSIONS

Based on the macroseismic surveys, the broad area within which the tremors were felt has been demarcated (Fig.3). This covers nearly 25 sq km area and is elongated in

ENE-WSW direction. The longer axis of the felt area is around 6 km. This shows the extremely localized nature of the swarm activity. Within this area, the intensity of widely felt events such as those of 16th April 2000 and 28th May 2000 appeared to have been above IV in MSK-64. Rarely the intensity might have reached above V as evident from the appearance of a new spring between Bamhori and Gadarwara during the summer months. Since the swarm activity is not felt in the villages Kuddo and Palla, rapid attenuation is inferred. As the events were accompanied by blast like sound, their source region may be very shallow. Although no exposed fault could be traced on the surface in the study area, the possibility of hidden basement faults beneath the Deccan Trap cover cannot be ruled out.

In general, the seismic activity felt in Bamhori area has the following characteristics:

1. There appear to be periods of high incidences of tremors followed by a brief lull.
2. Tremors are localised within a small area of 25 sq km around Bamhori and are accompanied by acoustic emissions.

Based on these characteristics, the seismic activity around Bamhori can be considered as another earthquake swarm within the Deccan Volcanic Province, in addition to the previously known swarms such as Pandhana. The Pandhana swarm activity near Khandwa has been studied in detail by GSI and IMD (Mishra et al. 2000). A characteristic feature of the Pandhana swarm is the occurrence of most tremors immediately after the monsoons. The limited data available on the Bamhori swarm do not allow for making such generalizations. Nevertheless, in the light of the recent earthquakes in the Deccan Volcanic Province which in certain cases were preceded by swarm type seismic activity, the Bamhori swarm warrants monitoring and analysis by a network of short period digital instruments.

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Announcement

REFRESHER COURSE ON NATURAL RESOURCES MANAGEMENT, ENVIRONMENT AND EMPLOYMENT FOR COLLEGE/UNIVERSITY TEACHERS

The Science Education Panel of the Indian Academy of Sciences is sponsoring a Refresher course for college/university teachers in earth sciences on the theme, "Natural Resources Management, Environment and Employment". The course is being organised by the Mahadevan International Centre for Water Resources Management, Hyderabad, and the Jawaharlal Nehru Technological University (JNTU), Hyderabad, in the Kukatpally campus of JNTU during Nov. 3 (MO) - 15(SA), 2003. The International Association of Geochemistry & Cosmochemistry and the Geological Society of India are among the institutions co-sponsoring the course.

The purpose of the Training Course is to orient the university teachers so as to enable them to offer internet-based, employment-oriented courses to improve the employability of the earth science graduates, through focusing on economically-viable and ecologically sustainable utilisation of natural resources, namely, water, soil and minerals.

The resource persons will include not only experienced teachers, but also specialists in some exciting areas which are relevant to job opportunities for geoscience graduates (e.g. east coast gas deposits).

Interested teachers are invited to submit by Email their C.V.s, together with a two-page (-1000 words) essay, covering (i) the kind of geoscience that the candidate is presently teaching, and how it can be oriented to improve the employability of geoscience graduates, and (ii) what the teacher seeks from the course in order to enable him/her to orient their teaching to promote employment. As a part of the interactive course, each candidate is expected to make a 30 min. presentation on his / her perceptions and expectations.

The application, together with a letter of permission from the employers, should be submitted to Prof. B. Venkateswararao of JNTU (cwrjntu@yahoo.com), under copy to Prof. K.V. Subbarao of IIT, Mumbai (subbu@iitb.ac.in), on or before September 1, 2003. Selected candidates will be informed in the first week of October 2003.

For further details, please contact: Course Director: Prof. U. Aswathanarayana, Hon. Director, Mahadevan International Centre for Water Resources Management, contact address: B-16, Shanti Sikhara Apts., Somajiguda, Hyderabad - 500 082, India. Phone: +91-040- 23399440; Fax: +91-040- 2232 9142; Email: uaswathanarayana@yahoo.com Joint Course Director: Prof. K.V. Subbarao, Dept. of Earth Sciences, IIT, Mumbai 400 076, India. Email: subbu@iitb.ac.in. Course Coordinator: Prof. B. Venkateswararao, Head, Centre for Water Resources, JNTU, Hyderabad -500 028, India. Phone: + 91-040- 2330 7178; Fax: 91- 040-2330 6095; Email: cwrjntu@yahoo.com