Low Frequency Acoustic Signals Detection of a Mine Explosive Blast Occurrence in Bogoso, Ghana

Amartey Edmund O.*

National Nuclear Research Institute, Ghana Atomic Energy Commission, P. O. Box LG 80, Legon-Accra, Ghana.

E-mail: edalaska2000@yahoo.com

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Abstract

An explosion occurred on 20 January 2022 in a suburb of Bogoso, in the Western part of Ghana. The blast was as a result of a collision between a truck transporting mine explosive materials with a motorcycle. The accident resulted in a major explosion in the surrounding areas which was observed by many residence and destroyed lives and property devastating the township. As a result, the blast energy produced was propagated through the atmosphere with infrasound waves generated. This low-frequency waves generated were detected by pressure sensors of the infrasound network of the International Monitoring System (IMS). The infrasound signals from this explosion were propagated to range of ~325 km to be recorded at I17CI station of the IMS network.

1. Introduction

On 20 January 2022, an explosion occurred in a suburb of Bogoso, in the Western part of Ghana. The blast was as a result of a collision between a truck transporting mine explosive materials with a motorcycle [1, 2]. The accident resulted in a major explosion in the surrounding areas which was observed by many residence, *causing* destruction to lives and properties in the community [1]. The resultant blast energy produced, generated infrasound waves as well which was propagated through the atmosphere [3]. These low-frequency waves generated were detected by pressure sensors of the infrasound network of the International Monitoring System (IMS) [3, 4]. The infrasound signals from this explosion were propagated in the atmosphere to be recorded at I17CI station of the IMS network. In this study, the use of infrasound detections to determine the explosion's characteristics.

Fig. 1 Explosion of mine explosive materials

2. Background of Blast Occurrence

A truck transporting mine explosive materials materials (Ammonium Nitrate and Fuel Oil (ANFO)) on 20January 2022, from an explosives plant, located at Iduapriem, Tarkwa in the Western Region, to Chirano Gold Mines Limited's site in the Western North Region, had a collision with a motorcycle. around time 13:25 GT along the way in a suburb of Bogoso, in the Western part of Ghana [1, 2]. The incident resulted in a major explosion several minutes later in the surrounding areas which was observed by many residence, destroying lives and properties [1, 2], and causing anxiety in the township (Fig. 1). Report indicates thirteen (13) persons died from the blast, while some hundred (100) people were injured, with several others homeless due to the severe impact of the explosion to the community [1].

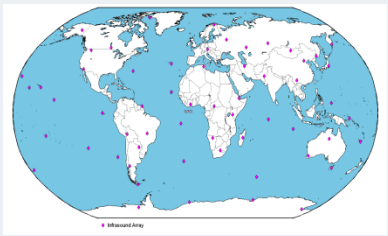


Fig. 2 Location of I17CI infrasound station in the IMS network

3. Infrasound Observations and Data Processing

This mine blast event was observed at the IMS infrasound station I17CI, *located in* Dimbokro, Cote d' Ivoire. The infrasound array station I17CI, has a 4-element centered triangular array configuration with low-frequency pressure sensors [5] as shown in Figure 3. Array apertures is 3 km. Infrasound signal detection, processing and beamforming were done using the Progressive Multi Channel Cross Correlation [6] , applied in infrasound processing.

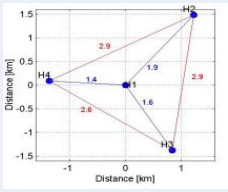
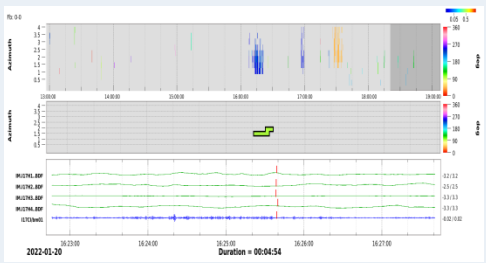


Fig. 3 I17CI array configuration



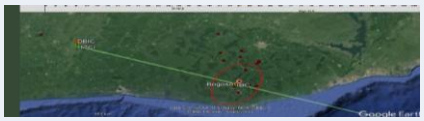


Fig. 5 Infrasound detection of the explosion of mine explosive

4. Propagation of *Accoustic* Waves in the Atmosphere

Infrasound propagation depends on the atmospheric wind structure, allowing the signals to propagate in the acoustic wave guide between the ground and the layers of the atmosphere *(ie.* troposphere, stratosphere, and lower thermosphere). Several phase arrivals may reach a sensor for them to be recorded . In this case,

5. Event Characterization

Infrasound signals propagated in the atmosphere with the arrival of stratospheric phase at 16:25 GMT at a frequency of 1.855 Hz and at a speed of 1.769 km/s.

6. Conclusion

The energy released by the mine explosive materials in a suburb of Western part of Ghana was large enough to generate low-frequency pressure signals to propagate through the atmosphere to be recorded at infrasound array station I17CI IN Cote D'Ivoire.

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