BMR Journal of Australian Geology & Geophysics, 11, 119-121

DISCUSSION: The elusive Cook volcano and other submarine forearc volcanoes in the Solomon Islands

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A recent paper (Exon & Johnson, 1986) in this journal concluded that activity attributed in the past to the Cook submarine volcano, in the forearc region of the New Georgia Group of the Solomon Islands, was probably largely hydrothermal blowouts from a sea floor vent (or vents) 1300 m below sea level, rather than volcanic activity.

Surveys of the three research vessels *Vulcanolog*, *Machias*, and *Moana Wave* show nothing resembling a volcanic feature at the position (approximately 8°25′ S, 157°06′ E) reported by HMS *Cook* in 1963, where that ship found a shoal depth of 36 m and sulphurous fumes. I suggest that an error was made in the original report of the volcano's position, and that it might lie outside the area surveyed either by R/V *Vulcanolog* or *Machias*. (The area surveyed by R/V *Moana Wave* is not known to the writer).

I have recently examined a copy of the *Cook*'s bridge log for the night of 14/15 December 1963, when the volcanic activity was first reported. I have spoken to and corresponded with *Cook*'s Commander at the time, Commander Hunt. All quotations in this discussion are his.

There are some inaccuracies in Exon & Johnson's paper which need to be corrected, for they affect the issue of the 36 m sounding. First, a submarine sentry is not an acoustic device but a 'practical old fashioned warning device used in early survey ships until echo sounding was established as reliable'. In essence, it is an underwater kite towed behind a ship — in *Cook*'s case 'at about 35 fathoms' (65 m) — with an arming lever protruding down. When this lever strikes the bottom a catch is released, and the kite no longer tows horizontally but at a large angle to the water flow. It then rises to the surface where it causes a plume of spray, visible to a man posted on the quarterdeck for that purpose. It is improbable that a turbulent column of gas and water could have triggered the sentry, although *Cook* had difficulty preventing false alarms caused by incorrect lengths of the kite's tow slings.

Secondly, it is not true that the sailors on *Cook* were inexpert in the use of the lead line. The Commander of *Cook* was 'one of the few really experienced men in the Surveying Service', with extensive experience in its use since 1942. Although he is not certain after all these years, he thinks that he himself felt the hand lead. The lead (weighing 6.4 kg), seemed 'to be sliding down something soft, or into it', and he assessed the beginning of the slide as the shoalest sounding. He is certain that there was sand stuck to the tallow in the heel of the lead. There can be little doubt that the lead line found the bottom. It is worth recording that the Commander of *Cook* was not unfamiliar with volcanoes. His previous posting was as Oceanographer to the Hydrographer of the Royal Navy, and in that capacity he served on the Royal Society Committee on Volcanology.

The bridge log of *Cook* records that, early in the evening of 14 December (all times are local), the ship was in Blanche Channel with courses (unrecorded) as required to land a two-man geological party at Munda Bar. Between 2230 and 2240 the ship was stopped (at a position not logged) while these two men were transferred to a launch from Munda. Although Grover (Grover, 1968) wrote that the rendezvous took place half a mile off Munda Bar, it is not uncommon for the first of two vessels at a rendezvous to move towards the second vessel. There was no compelling reason for the transfer to have taken place off Munda Bar, and the principal assumption in what follows is that the transfer took place between Roviana Island and the islets to the north of Rendova Island. The bridge log recorded that the wind was between 5 and 10 knots (2.5–5 m/s) and that the waves were 0.3 to 0.6 m high. It is reasonable to assume that a launch was at sea about 15 km from Munda Bar, but about 2 km from the fringing reefs and islets south of Munda, through which it may have been possible to pass, even at night.

From 2250, *Cook* steered 240° by gyro compass or 238° True, and no further course alterations were logged before 2325, when the submarine sentry was tripped. Two hundred and forty degrees is a typical course for clearing the confined waters between New Georgia Island and Rendova Island, if the next port is via Vitiaz Strait.

Cook's speed as it left the rendezvous was not logged, although at 2300 the log recorded a mean shaft revolution rate corresponding to normal cruising speed, and this is what would be expected for a ship on passage. During 14 and 15 December, cruising speed was 11.7–12.5 knots. It is reasonable to assume that *Cook* made good an average ground speed of 12 knots in the 45 minutes between getting underway and when the sentry tripped, and so travelled about 9 nautical miles or about 17 km.

Figure 1 shows the estimated position of the 36 m sounding under the two assumptions of disembarkation point and ship's speed. This position lies just outside the area surveyed by *Vulcanolog* and *Machias*. Interpretation of the sounding traces is likely to have been made more difficult by the Vulcanolog's change of course and the underlying irregular, shoaling bathymetry. Figure 3 of Exon & Johnson indicates a water depth here of about 850 m. The circle with 1.5 km radius centred on the estimated position includes other possible locations for the volcano, given the uncertainties in rendezvous location, ship's speed and course made good.

Grover put the volcano at a bearing of 241° True, 6.7 nautical miles from Unda Point. This is not the position 8°24.9′ S, 159°06′ E that he also quotes. The location now proposed bears 241° from Kosianae Point, the southeastern extremity of Roviana Island. Another prominent radar feature, Hofovo Point (formerly known as Baniata Point), the western extremity of Rendova Island, lies 6.7 nautical miles away. It is possible that, in the confusion caused by an 'eerie and alarming... occasion', when the prime concern of the ship's Commander was to avoid grounding on what he considered to be an active volcano, the ranges and bearings of the various radar features became exchanged.

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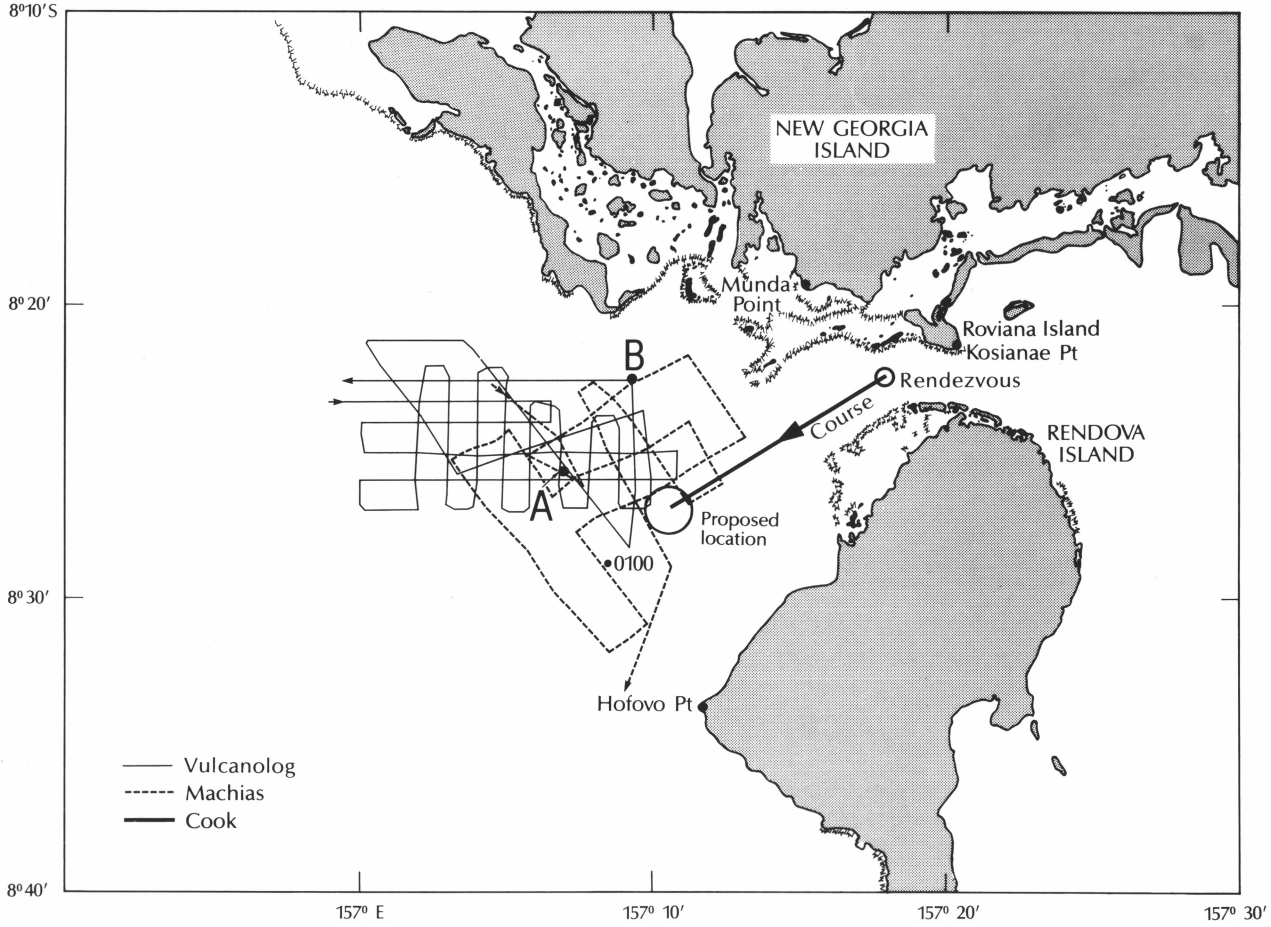

Figure 1. Tracing of Admiralty Chart 3995 showing the new estimated position of the 36 m sounding (surrounded by a circle of radius 1.5 km), *Cook*'s assumed track between 2240 and 2325 (local time) and *Cook*'s 0100 position (from *Cook*'s bridge log).
The earlier reported position of the volcano is marked A and the position also reported by Grover (Munda Point 241°, 6.7 nautical miles) is marked B.

There is surely the need for yet another survey before the Cook submarine volcano can be confidently removed from the list of volcanoes active in recent time.

I gratefully acknowledge the cooperation of Commander (H) F.W. Hunt, MBE, RN (Retd), who was in command of HMS *Cook* in 1963. The responsibility for the inferences drawn from the available data, however, is mine.

References

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REPLY

N.F.Exon[1] & R.W.Johnson[2]

We welcome Hall's discussion of our paper. The first point raised by Hall deals with the evidence of a shoal provided by the 'submarine sentry' used from HMS *Cook*. The sentry triggered when streamed in about 65 m of water. We are grateful for Hall's description of how the sentry operated. We accept that a mechanical device of that type, if rigged properly, probably was less likely to be triggered by a turbulent column of gas, water, and sediment than would be an acoustic device. However, we note Hall's statement that on the *Cook* there had been 'a continuing difficulty in preventing false alarms caused by incorrect lengths of the tow slings to the kites' on the sentry, which casts doubts on the general reliability of the equipment. Furthermore, we remain unclear whether triggering could have been caused by contact with a turbulent column, either by the sentry being tossed around, or by its contact with sediment or even rocks in the water column, and particularly if the sentry was rigged incorrectly as well.

The second point deals with the soundings taken with the lead line, and their meaning. The evidence presented by Hall strengthens the case that the soundings were meaningful, and that bottom really was struck. The *Cook*'s commander, unlike his crew, was experienced with the hand lead, and he believes it contacted bottom, and is certain it had sand stuck in the tallow in its heel. However, major turbulence from a deepwater hydrothermal vent conceivably could have confused the lead men (if they, rather than the commander, took the soundings) and the sand could have been carried up in a turbulent plume.

Hall's arguments about the possible location of HMS Cook on the evening of 14–15 December form a logical, but as yet unproven, basis for accepting the position of the vent that he proposes (that is, south and east of the other possible locations, A and B, and just outside the grids of the R/V *Machias* and R/V *Vulcanolog* surveys) as a possible alternative to the ones claimed by J.C. Grover. This new position is also east of the area surveyed by R/V *Kana Keoki* using the Sea-MARC II side-scan sonar system in December 1985.

If a volcano had come almost to the surface at the location suggested by Hall (about 8° 27′ S, 157° 10.5′ E) and had slopes of 25° like those of Kavachi submarine volcano, it would have had a base diameter of about 3.5 km in water 800 m deep, the prevalent water depth in that general locality. A structure even of that size could conceivably have been missed by the surveys carried out. Frustratingly, the proposed position is perfectly positioned immediately outside the existing data grid! Alternatively, post-volcanic mass wasting could have removed all or most of the volcano since activity stopped in 1964. Kavachi volcano, presumably representing the sort of structure Cook volcano might be, has been above sea level seven times since 1952 (Johnson & Tuni, 1987), but has also in that period been as deep as 180 m below sea level (Okrugin, 1985). Karua volcano, in Vanuatu, is another similar volcano. It was above sea level in 1974, but there was no evidence of it near the surface in 1981 (Exon & Cronan, 1983).

We conclude that Hall is right when he says that yet another survey is needed before Cook submarine volcano can be confidently removed from the list of volcanoes active in recent times. Nevertheless, we still doubt that the current evidence for its existence as a major subsea cone in 1983 is strong. Furthermore, if the volcano existed at all, mass-wasting since 1964 may well have eroded it to a depth where it is no longer a hazard to shipping.

References

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