

ANSWER TO DISCUSSION BY DR. P. E. GRETENER ENTITLED
"IS THERE AN EXPLANATION FOR GRAVITY
ANOMALIES ASSOCIATING WITH REEFS?"

By

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In answer to Dr. Gretener's discussion in which he finds exception both to Yungul's and my own explanation for the gravity anomalies associated with reefs, I, too, question Yungul's explanation of an increase in sand content vertically over the reef due to the winnowing action of waves, etc. My questioning of that explanation was the reason for offering another idea, although in some cases Yungul's explanation could be correct. I believe that as a single article, Yungul's casts more light upon the subject than any other I have read.

As I see it, Dr. Gretener has simply restated the problem, the fact that it is difficult to explain the source of the shallow positive anomalies which often occur in coincidence with pinnacle reefs. As he has demonstrated, the anomaly resulting from the reef mass itself, and from the anticlinal draping above the reef, does not fulfil the anomalies measured in the field. My own efforts have been directed toward explaining the cause of the observed anomaly.

From Dr. Gretener's discussion, it appears that he does not recognize the presence of denser rock vertically over a reef in the sense that a change in density might occur laterally within stratigraphic time units. I am convinced that this does occur. My basis for thinking this is the report by Pohley, 1953, (quoted by Yungul) to the effect that "dip shown for the beds above reefs on seismic maps are often greater than those encountered in drilling." He further states that "this may be considered as indirect evidence of a lateral increase in density over reefs, because a velocity increase is usually accompanied by a density increase." I have spoken to numerous geophysicists who verify this velocity phenomena. I believe that the increase in velocity, and density, may be the cause of the unexplained anomaly amplitude. In my mind, what causes the lateral increase in density above the reefs is the pertinent issue. Obviously, an anomalous mass exists for there to be an anomaly.

Dr. Gretener criticizes my analogy of coins surrounded by foam rubbed with a book on top, to demonstrate the greater compaction above the reef; the book representing the rigidity of the shallower beds and their resistance to bending. Rigidity here will cause an increase in density laterally. It must be remembered that an infinitesimal increase in compaction and density (1%) is all that is required to provide the observed anomaly.

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Dr. Gretener states that "unfortunately this model is unrealistic. The overburden consisting of the youngest and weakest sediments do not behave like a rigid block. These sediments will deform, as proven by the draping and the effect postulated by Hays is mechanically unacceptable." My question is why. Simply because rocks will deform does not prove that they lack rigidity and resistance to bending. Because they display draping does not prove that there is no resistance to draping. It is this resistance to deformation which may cause the small differences in compaction in the on and off reef positions. A steel or wooden beam will deform and drape when placed over a fulcrum, and the fact that it is deformed does not prove that rigidity does not exist. All solid materials have some resistance to deformation. The issue is whether the degree of resistance is sufficient enough to cause the density contrast required to provide the gravity anomaly.

Frankly, I cannot find a better explanation for the extra substance mass and the gravity anomaly. I am ready to entertain any other thoughts that might be offered. I still fail to see why Dr. Gretener finds this particular explanation "mechanically unacceptable."

Again, Dr. Gretener has restated the problem and demonstrated the fact that the explanations offered are difficult to prove and are not universally agreed upon. I would welcome any effort he might make toward explaining the anomaly phenomena.

In either event, the fact remains that there is an observable empirical relationship which is usable in many instances. I am still waiting for a better explanation.