(Seismic Study on The Southern Part of The Tiehchenshan Structure)

鐵砧山構造南端震測記錄之研究

駱劍秋

摘 要

鐵砧山背斜構造是介於苗栗、台中間，離海岸不遠的油氣田，爲了對其南端有更進一步的瞭解起見，不但採用了震測所得的資料，同時更輔以重力所得，配合研究。從所繪打鹿砂岩地下等高線圖可看出高山尖逆斷層向北延伸，背斜之西翼較東翼陡峭，換言之，造山運動的力量來自東邊，并將斷層之東的地層擲過西翼地層之上。

在研究過程當中，最大的問題是如何獲取正確的横向波速變化資料，文中對所謂速度掃描有所說明，希望能促進我們自己資料處理的改進。

ABSTRACT

To understand thoroughly lower part of the Tiehchenshan Structure, we investigated not only the seismic data but also the Bouguer gravity map,and a contour map correlate to the top of Talu-Sand formation was thus made. The Kao-Shan-Jen thrust fault extended approximately due north. The west limb of the anticline is steeper than the east;in other words, the tectonic force came from the east, and threw the east block of strata over the west block.

To solve the problem of getting accurate information about the change of velocity in horizontal direction, a kind of method which we call it "velocity scan" was introduced in this article, with a motivation to initiate the data processing center to move a large step forward.

I INTRODUCTION

Tiehchenshan Anticline lies between Miaoli and Taichung, and is not far away from the coast of Taiwan Strait. Parallel to it is the Tun Shiao Anticline; in fact, both of them are constituents of the so called Tiehchenshan gas field. For the ultimate south end of this anticline, the author has given detailed description in his earlier article "Seismic Study in Jin-Nan Area". To complete the study of the lower part (in the sense of a map)of the anticline, we adopted not only the seismic data, such as time sections, but also Bouguer gravity maps.

The most serious problem we confronted when our work was going on was "how to acquire information about the change of velocity in horizontal direction". To solve this problem,not now, but in the near future, a kind of method we call it "velocity scan" was introduced in the item "suggestion" of this article.

II A BRIEF REMARK OF THE FUNCTION OF A.G.C. DESIGNING

Since the energy reflected from reflector of large depth is much weaker than those reflected from reflector of less depth, so the amplitudes of the waveforms produced by the reflected energy will differ from each other even more.

To record simultaneously all reflected energy on a comparatively narrow tape, the amplitudes of waveforms should be properly adjusted, this is why the Automatic Gain Control designed.

Now, let's take a quick look at the principle, the A.G.C. acts:

because $\left(\frac{S}{N}\right)_{\text{in db}} = 20\log\left(\frac{S}{N}\right)$

where $\frac{S}{N}$ is signal to noise ratio,

So, if $\frac{S}{N} = 1 \Longrightarrow 0$ db

$\frac{S}{N} = \frac{1}{2} \Longrightarrow -6$ db

$$\frac{S}{N}=\frac{1}{100}\Longrightarrow -40\ \text{db}$$

Again, if we choose arbitrarily four points, A,B,C and D on an input energy versus time curve. If, at A the energy picked is 100 mv, at B is 10 mv, at C is 1 mv, and at D is 10 μv (also the ambient noise level), then for reaching a "one volt" out-put energy level, the A.G.C. action is to multiply A by 20 db factor, and B by 40 db factor, C by 60 db factor and D by 100 db factor.

Of course, it takes time for A.G.C. to behave, usually we can select among slow (40 db/sec), medium (80 db/sec) and fast (120 db/sec), switch locations.

Take 40 db/sec as an example, since the recovery time (both attack time and release time are included) is long enough to make a dead line after a reflected wave, this makes the reflected energy to be grasped more easily, but in the cost that some useful information may be lost during the dead-line period. Consider of this, 80 db/sec switch location is selected ordinarily.

Ⅲ INFORMATION REVEALED IN SEISMIC PROFILES

General speaking, the quality of the reflection wave of profiles D.E.HH. 13,14,15,26 is fairly good. Take survey line No.14 as an example, the shot energy can reach a depth of even more than 3000 meters. The anticline is clear-cut in figure, the west limb is steeper than the east. After careful investigation, the profiles were picked according to the characteristic of the reflected wave, and a contour map was made then (see the contour map correlate to top of TaluSandstone attached in the pocket). From this map, we can see clearly that the Kao-Shan-Jen thrust fault extends approximately due north, and cut through the survey line 14 between station 38 and 39.

The culmination of the anticline structure is located not far away from the area where the survey lines 22,26 and GG tangled.

From all the features depicted above, we conclude that the tectonic force came from the east, and threw the east block of strata over the west block. This supposition can illustrate well why the reflection surface in the west is steeper than the east.

The thickness of stratum varies in different direction. For example, the Talu Shale is thinning toward the west, and the Kuanyinshan Sandstone is thinning toward southwest. This is mainly a problem of sedimentary history, and would not bd discussed any more here in this paper.

Ⅳ EVIDENCE DEPICTED IN TUNGHSIAO BOUGUER GRAVITY MAP

In the attached pocket, there is a Tunghsiao Bouguer Gravity map, the interval between contour lines is 0.5 milli-gal. From this map, we can find that the axis of the gravity high is drawn from Tunghsiao to Yue-Li, and the gravity low is tracked somewhat along the shore. It seems that a fault exist in between this two axis. Since the fault we have found from seismic profiles was thrust fault with fault plane dipping to the east in an angle about but less than 85 degrees, and because the mass along the fault plane of a thrust fault is almost double the mass some distance away from the fault plane; so, on the map we must set the fault nearer to the axis of gravity high (as that shown on the Bouguer Gravity map). Moreover, as we all know that gravity measurements are mostly affected by the near surface or surface mass, so the fault trace drawn was trace of the fault in the near surface block. Although, if track down the fault plane to a depth of about 3000 meters we will find still it will not coincide perfectly with the fault trace on top of Talu-Sandstone decided from seismic profile (shown by dashed line), but it still gives a powerful evidence to the existence of the fault. The lower part of the dashed line bend to the east is mainly due to the increasing of the depth of the reflector.

Ⅴ CONCLUSION

(1) The culmination of Tiehchenshan Anticline Structure is located not far away from the area where the survey lines 22, 26 and GG tangled。

(2) Judging from the seismic profiles we find the so called Kao-Shan-Jen thrust fault extended approximately due north, and cut through the survey line 14 between shot station 38 and 39. The gravity data gives a definite approbation to the existence of the thrust fault.

(3) From the fact that the west flank of the structure is steeper than the east, and also from the location of the thrust fault we concluded that the tectonic force came from the east.

(4) Investigate the structure carefully, it seems that oil and natural gas were accumulated only in the structure high, so drilling sites west to the fault are not recommended.

Ⅵ SUGGESTION

The most important purpose of seismic work is to interpret correctly the subsurface geological configuration. In other words that we must trans form the travel time into actual reflection depth. To do this we should know not only the velocity change against depth, but also the information of velocity change in horizontal direction.

For the convenience of explanation, we take the area north to Ta-Chia and next to the coast of Taiwan Strait for example: In this area , a lot of wells were drilled, but among them well KY-1 was the only one which did not cased, that means the velocity function derived in this well is the most reliable one (because casing effect was absent), but this does not assure that the data thus derived can be applied in making seismic interpretation of Pei-Sha-Tun and some places else. Due to lacking of information of velocity change in horizontal direction, we missed quite a few faults (both normal and thrust). All this were corrected already after some wells been drilled.

The method used to acquire the information of velocity change in horizontal direction is called Constant Velocity Stack (or Velocity Scan). The spirit of this mthod is:

(1) Take the 24 traces C.D.P. stack tape record at a certain point (more exactly a short interval) on the survey line.

(2) Use $\Delta T \doteq \Delta T_1$ (normal moveout) to correct the stack tape, doing this we can find a corresponding reflection time ${}_1T_0$ at which the short segments which represent for reflection surface is the most straight one. Repeat this procedure, pairs of ΔT and corresponding T_0 can thus be acquired.

(3) Use formula

$$\triangle T = \frac{x^2}{2 T_0 \bar{V}_{RMS}^2}$$

thus to each pair of T and T_0, we can find also the corresponding average velocity $\bar{V}$ (here we take $V_{RMS} \fallingdotseq \bar{V}$).

(4) Use formuls

$$Z = \frac{1}{2} T_0 \bar{V}$$

the depth correspond to each reflection time (two-way time) T_0 can be calculated easily then.

(5) Usually after 4 or 5 miles, another sample can be taken, and all the procedures described above will be done over again.

(6) If fault, or anticline, or something else exists in between, sample can be taken in less distance.

By doing these, we can get detailed information about the horizontal change of velocity of wave propagation.

May be a little money will be cost at the beginning, but I still propose for the sake not only to save the drilling expense of dry holes, but also to find correctly the positions of resources that we should start this work in our Data Processing Center. I hope that we can use this kind of data in the vast near future.

VIII ACKNOWLEDGMENTS

Funds from the National Council on Science Development for approbation of this study are always grateful by the author.

REFERENCES

Lo, J.C. and Juang, M.S., 1971, Discussion of A Noise Analysis Test held in the southern part of the Tiehchenshan Structure, Miaoli, Taiwan: Petroleum Geology Taiwan, no.9, pp. 173-180.

Pan, Y.S., 1971, Recent Development in Seismic Data Processing and Interpretation: The Bulletin of CIMME, Vol.XV, no.1, pp.91-94

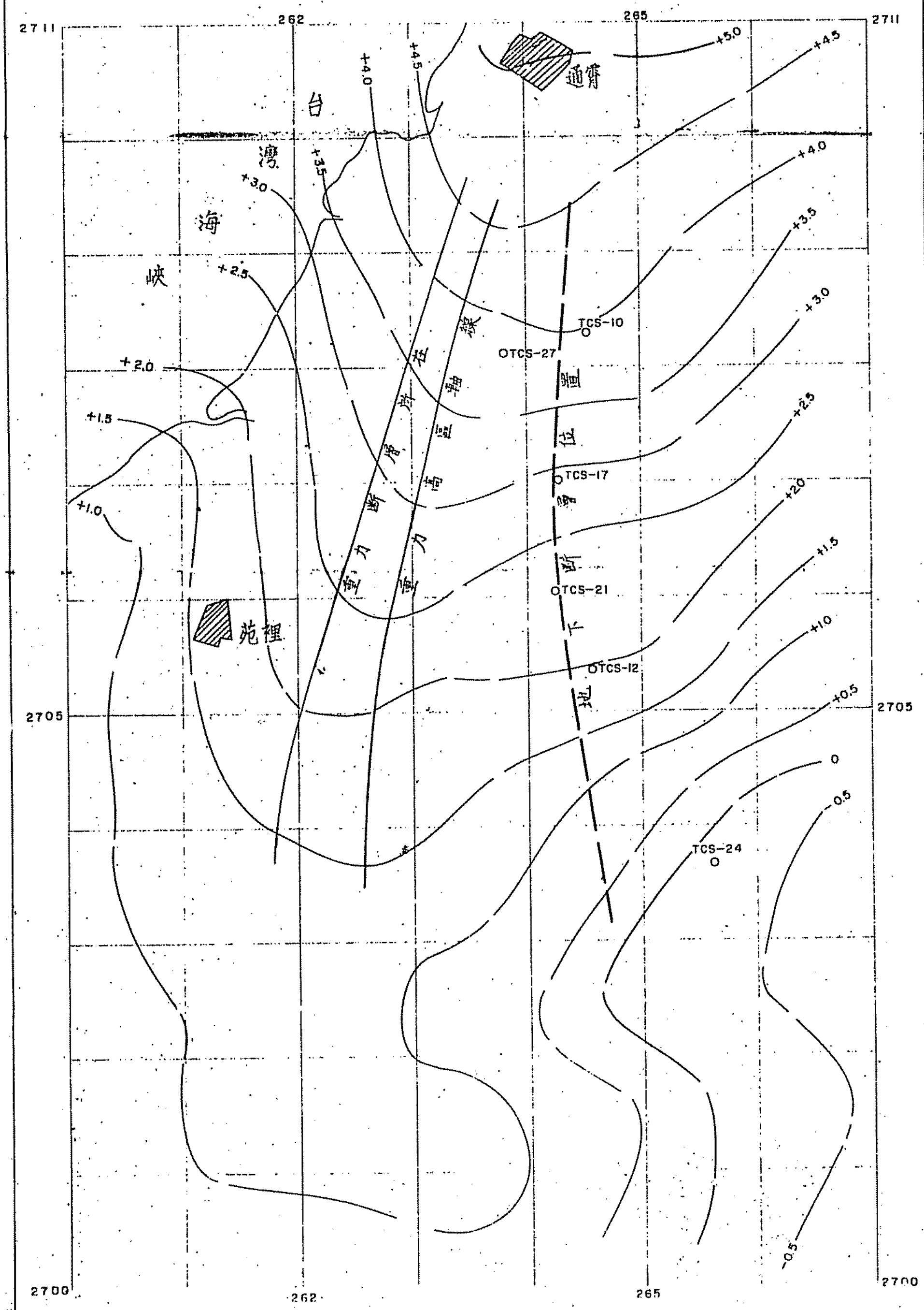
Rockwell, D.W., 1971, Migration Stack: Oil & Gas

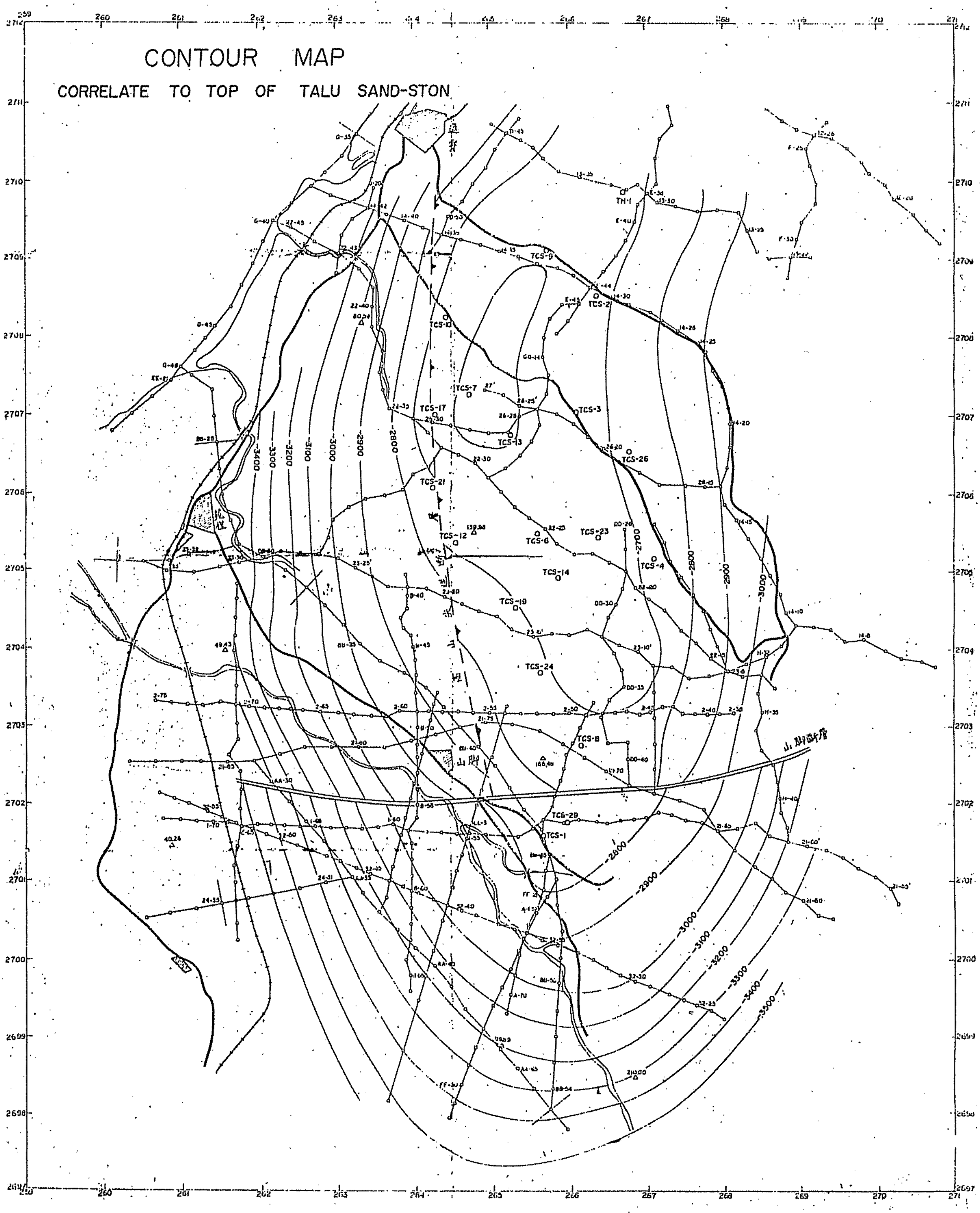
Journal, April 19.

Wadsworth, G.P. and Robinson, E.A., Detection of Reflections on Seismic Records by Linear Operator: Geophysics, Vol. XVIII, July 1953.

通 霄 布 蓋 重 力 圖

比例尺:　五萬分之一




CONTOUR MAP
CORRELATE TO TOP OF TALU SAND-STON
-3400
-3300
-3200
-3100
-3000
-2900
-2800
-2700
-2800
-2900
-3000
-2800
-2900
-3000
-3100
-3200
-3300
-3400
-3500
TCS-9
TCS-2
TCS-10
TCS-7
TCS-17
TCS-13
TCS-3
TCS-26
TCS-21
TCS-12
TCS-6
TCS-23
TCS-4
TCS-14
TCS-19
TCS-24
TCS-8
TCS-29
TCS-1
TH-1