Structure and Depth Study of a Reflector Appears on 52-Seismic Sections in Um-Al-Anz Area, Weastern Desert, Iraq.

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Abstract

A reflector was picked on (52) seismic sections, (2960 km length), in Um-Al-Anz area, western desert. It has two way time ranges between (2940-3700) msec. The reflector was identified throught correlating and tying the seismic sections of the surrounding area. The reflector represent the reflection from near top of the basement and most probably it was from a limestone bed (Cambrian age) which is covered the crystalline basement. Seismic maps, (Isochron, Velocity, and Depth), have been constructed for the reflector. The depth map shows that the reflector depths range between (6040-7600) m with respect to sea level. The general dip is toward west and southeastern. In structural point of view the present study denote to the existence of a very huge anticline in the western desert trending N40W. It has length and width range between (130 x 75) km. The depth map also shows the apperance of several anticlines have different dimension and closures. They have great importance in possibility of petroleum existence. Finally parts of the two major faults, Abu-jeer and Umage-Samara-Halabja, have been detected and plotted on the isochron and depth maps.

الخلاصة

تم التقاط عاكس على (52) مقطع زلزالي يصل طولها الى 2960 كم في منطقة ام العنز ضمن الصحراء الغربية، له زمن مزدوج يتراوح بين (2940–3700) مثانية. لغرض تعريف العاكس ولعدم وجود آبار في المنطقة والمناطق المجاورة أجريت المضاهاة وربط المقاطع الزلزالية لمنطقة أم العنز مع مثيلاتها في منطقة الفضوة التي فسرت سابقاً وتقع شمال منطقة الدراسة، اظهرت عملية الربط بان العاكس هو انعكاس من سطح قريب من قمة القاعدة وبالاحرى يمكن ان يكون انعكاس من طبقة جيرية تعود الى الكامبري وتغطي سطح القاعدة الصخرية.

تم تحضير خرائط زلزالية (زمنية،سرعية و عمقية) لهذا العاكس. الخارطة العمقية بينت بان عمق العاكس يتراوح بين (6040 – 7600) م من مستوى سطح البحر. وبصورة عامة يميل نحو الغرب والجنوب الشرقي. من الناحية التركيبية اشارت هذه الدراسة الى ظهور تحدب تركيبي كبير وفريد من نوعه في الصحراء الغربية يتجه N40W ذات ابعاد يتراوح بين (70 × 130)كم بالاضافة الى ذلك اظهرت الخارطة العمقية عديد من التراكيب المحدبة ذات ابعاد وانغلاقات مختلفة ولهم اهمية جيولوجية كبيرة في احتمالية وجود النفط والغاز.

أخيراً تم التقاط جزء من الفالقين الكبيرين أبوجير و اميج–سامراء– حلبجة على المقاطع الزلزالية وحدد على الخارطتين الزمنية والعمقية.

Introduction

Seismic reflection surveying has been used since the mid-1920s to map subsurface geology-primarily for petroleum exploration. The ability of seismic data to resolve geologic features is governed by the spacing of the geophones on the surface, the frequency of the reflected signal, and the velocity structure of the subsurface,[1]. Seismic reflection applications with investigation depths about (3-9) km are sparse due to

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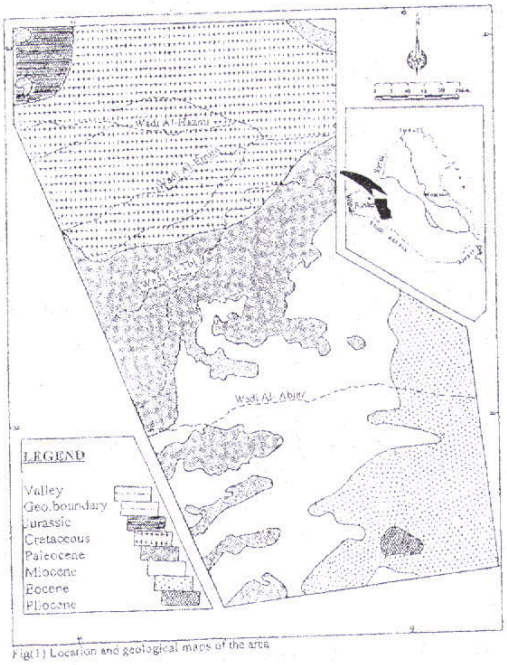
resolution limits of the method. The large difficulty encountered is related with the separation of the signal from noise and the facts that the amplitude of the reflections can be smaller than that of coherent noise,[2].

Um-Al-Anz area is located at the middle part of the western desert, southwestern Baghdad by about (300) km, Fig(1). The maximum length and width of the area is (176 x 104) km respectively, occupying an area estimate to be about (16897) km2. It is lie between longitude (40°50`- 41° 15`) and latitude (31° 30`- 33° 05`).

Topographically, surface of the area is very complex, many V-shape valleys have been seen, most of them trending east-west or north- east such as wadi Al-Hazmi, wadi Al-Tbl and wadi Al-Abiaz. In addition several anticlines are covered surface of the area having high reaches about 450 m ASL. The surface of the area generally dipping toward southeast.

The direction of the seismic lines depend on the available geological and geophysical information about the area. At the northern part two sets were laid out trending NS and EW, while in the middle and southern part two others sets were laid out trending N35W and N55E.



Fig(1) Location and geological maps of the area

Seismic Reflection Acquisition Parameters

About (70) seismic lines were laid out, total length of them reaches about (3550) km. The distance between the seismic lines ranges between (6-9) km, and they have different lengths range between (20-85) km. The grid density equal to (0.28) km/km2.

The field program carried out by the France seismic teams No.8 and No.11, using four vibroseis as a source of energy of MERTZ type. The length of geophone spread is equal to (4900) m and No. of traces is (48) separate by a distance (100) m, thus the fold of coverage is equal to 24%.

Tectonic Setting and Geological Condition

The studied area is part of Iraqi western desert which belongs to the stable shelf of African-Arabian platform, [3]. Rutba uplift is the main importance structure within this shelf locate at northwestern Um-Al-Anz area, Fig(2).

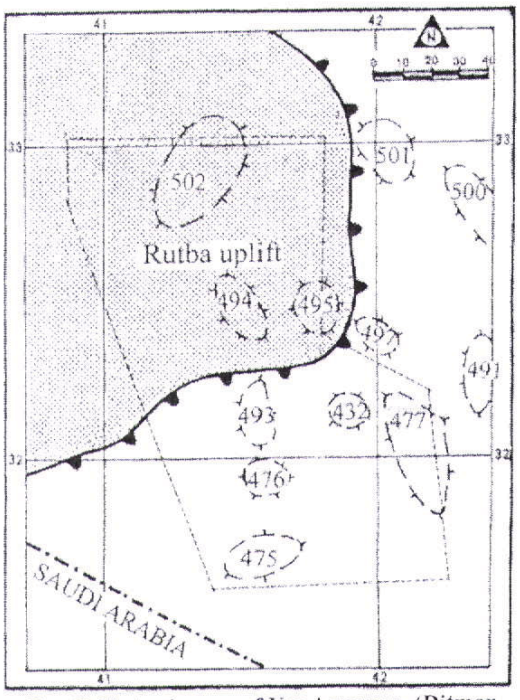


Fig (2) Tectonic map of Um Anz area, (Ditmar, 1979)

According to basement tectonic framework of Iraq complied from [4] the basement is divided in to blocks and sub-blocks by a series of major lineaments striking NW-SE and NE-SW, which subdivide the main zones and sub-zones. The basement beneath Um-Al-Anz area includes the Horan-Sulaimany and Ramadi-Baquba sub-zones of the central-Iraq block.

The surface geological map of the area, Fig(1), shows that in the north and northwestern part

those rocks are outcropped which are return to Jurassic, Cretaceous and Tertiary. Toward east and southeastern the rocks of younger age are appeared.

Several geological formations have been seen on the surface such as Ubaid Dolomitic Fn.,Umage carbonate Unit, Rutba Sand Fn., Musaad Dolomitic Fn., Tayarat Fn., Um-Razuma and Dammam Fn., most of them are composed of carbonate rocks.

Interpretation

I) Identification of the Reflector

Identification of a reflector on a seismic sections is not a facilitate work especially if there is no wells drilled in the area or adjacent areas. In such situation we make use of the geological and geophysical information available about the area and the surrounding. Fortunately Fadhwa area which is located north of Um-Al-Anz was interpreted by [5] using seismic reflection data.

Two seismic lines of good quality in Fadhwa area were selected for the sake of correlation, they are Fa-15 and Fa-19, These lines intersecting Az-13A and Az-17A respectively. The datum plane of these two sets is corrected to 400 m above sea level. The reflector under consideration appears to be reflection from a cycle close to the top of basement. Also according to the correlation process between the seismic line passing through the well (Tenaf-1) in Syria near the western border of Iraq with some seismic lines in parts of western desert, the studied reflector represents a reflection from a limestone bed return to cambrain age covers the crystalline basement, [6] & [7].

II) Picking Process

After identification and indication the reflector on the two seismic lines AZ-13A and AZ-17A the reflector had been picked on the rest 50 seismic lines. The precision of the picking process stand on the quality of the seismic sections. At northern part the quality is very good except some parts locate at north-eastern the quality changes to fair and then to bad. The middle part of Um-Al-Anz shows fair to bad quality this most probably return to complexity of the topography. In southern part the quality generally is good except some parts in southeastern display bad quality.

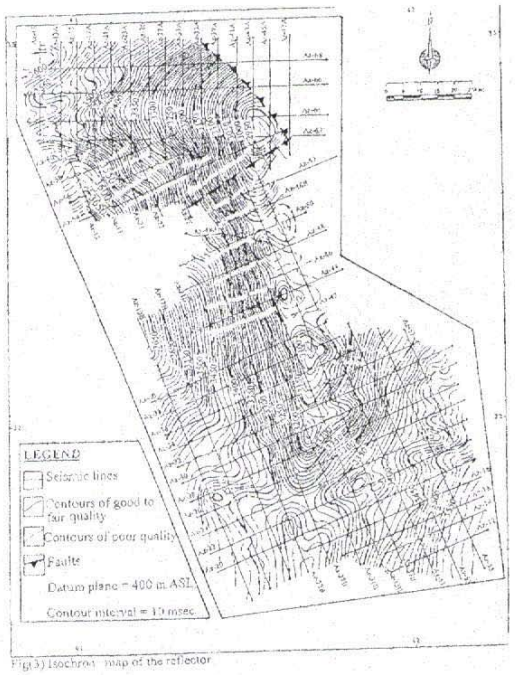
The picking process was carried out without problem except the apperance of a small amount of misties at the intersection points of the seismic lines. The magnitude of about (5-15) msec have been recorded. At those places where it is equal to (5) msec the amount is negligible, while in places been exceeds this magnitude it is distributed to the adjacent shot points.

III) Seismic Maps

A-Isochron Map

A large number of two way time readings were measured. This is due to constructing a precise isochron map so that all information have been preserved such as those small structural closures equal to (10) msec. When the reflector is horizontal the readings were taken every (2) km, while the measuring been more dense when changes of dip is observed.

Finally the readings,(TWT), are plotted on the base map of Um-Al-Anz area, then by a suitable C.I equal to (10) msec the isochron map was constructed, Fig(3).



Fig(3) Isochron map of the reflector

The minimum TWT for the reflector appears at northeastern part equal to (2940) msec and the maximum amount appears at the west of the middle part equal to (3700) msec. The northern part of the area characterize by appearance of a large closure contour (I), its peak locate near the intersection point of the lines Az-43A and Az-62, but as we moved toward west the reflector change to a general dip of average horizontal slope equal to (10) msec/km, this part represent the western limb of the large closure.

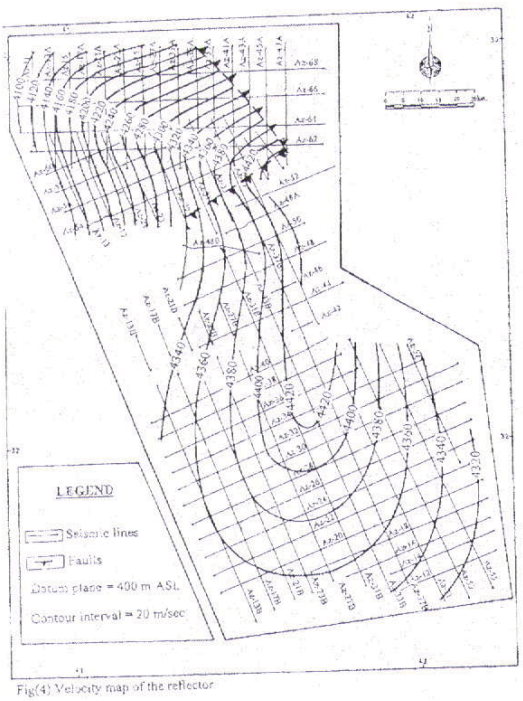
The middle and southern part of the studied area are complex in structural point of view, several closures were appeared, some of them are locate on a straight line such as (I, II, III, IV, V, VI, VIII), while others are scattered randomly at southern part such as (VII, IX, X). The table below shows description of the contour closures:

No	Closure (msec)	Dimension (km)	Coordinate
I	20	8.3 X 11.6	32° 45` - 41° 33`
II	10	4.2 X 7.1	32° 31` - 41° 36`
III	20	8.0 X 10.7	32° 27` - 41° 34`
IV	40	13.3 X 13.9	32° 20` - 41° 36`
V	50	11.5 X 20.8	32° 11` - 41° 41`
VI	20	4.0 X 6.5	31° 58` - 41° 40`
VII	20	3.1 X 5.6	31° 57` - 42° 02`
VIII	10	1.6 X 4.2	31° 50` - 41° 53`
IX	10	1.7 X 3.2	31° 48` - 41° 25`
X	20	3.2 X 6.5	31° 44` - 41° 36`

B-Velocity Map

Seismic velocity is defined as the speed that sound waves travel through the sediment and the rock layers. This information is required for calculating the actual depth to an acoustic reflector. In addition, reflections occur at significant velocity boundaries, so a velocity profile or velocity map can be used to predict the occurrence of the reflectors or analyze the actual depth of observed reflections,[8]. The great problem for geophysics is a suitable decision for using a precise velocity in the interpretation process, [9]. Velocity analysis study had not been carried out in the area due to abundance of wells in the area. For the purpose of time/depth conversion all accessible velocity information may be used, [10]. So we used stacking velocity available in the velocity analysis boxes exist on the upper portion of the seismic sections. Seismic velocities derived from staking of the conventional reflection data provide only a limited possibility for time-to-depth conversion,[11].

The stacking velocity can be used instead of average velocity in desert area or those areas which are topographically simple, [12]. So a set of stacking velocity readings were taken on each seismic section, later plotted on the base map in their proper positions, then by smoothing process and selecting a suitable C.I, (=50 m/sec), the velocity map was constructed, Fig(4).



Fig(4) Velocity map of the reflector

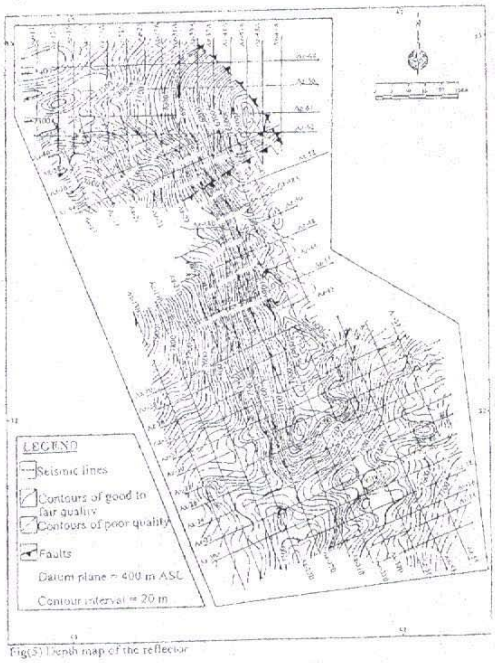
The velocity map shows that the reflector velocity ranges between (4000-4440) m/sec. The minimum magnitude is observed at northern part and it is increase as we move toward southeastern part of Um-Al-Anz. The velocity change in the southern part is small as compared with the northern part and it is range between (4320-4420) m/sec.This is clearly emphasis the flatness of the reflector in this part of the area. According to, [13] a flat overburden, the lateral velocity changes are small, while structural data shows large lateral velocity changes.

C-Depth Map

The most common depth conversion method over the last few decades has been to use functions derived from well data. Staking velocities have traditionally been regarded as less precise, and have only been preferred in those cases where lateral variations were dominating [13]. In recent years this has changed. Modern staking velocity data and methods are of better quality, due to improvements in seismic processing and numerical modelling techniques. Today, staking velocity depth conversion is the preferred method in many areas around the world. Stacking velocities can predict depth with an accuracy of 99%, that is, with 1% error, [13]. This remaining error is due to noise. Most of the noise is not random noise, but signal caused by

effects that our methods don't take into account. The most important is non-hyperbolic moveout. Dip is less important, especially after DMO correction.

Two methods were used for drawing depth map, the first, the velocity map was drawn on a transparent paper and coincided with the isochrone map, and then depths to the reflector were determined at each intersection point. So with suitable contour interval equal to (10) m the depth map have been constructed, Fig(5).



Fig(5) Depth map of the reflector

The second is by employing Surfer Ver.8 software, Fig(6). There are slight differences between the two depth maps especially in the dimensions of the closures as clarify in table (2).

Structurally, from the depth map, the reflector is considered as a very large anticline, detected for the first time in the western desert. The minimum depth to the structure is (6040) m and the maximum reaches to (7600) m from sea level. It has length and width range between (130 x 75) km respectively. It is considered as a very importance geological feature, so a detail study will be necessary to carry out in future especially at the eastern part which display zone of no data.

The axis of the structure is running N20W. The highest point appears at northern part below the intersection point of the seismic lines Az-43A and Az-62. As we moved toward northwestern part this situation is changed to a general dip,(=25 m/km).

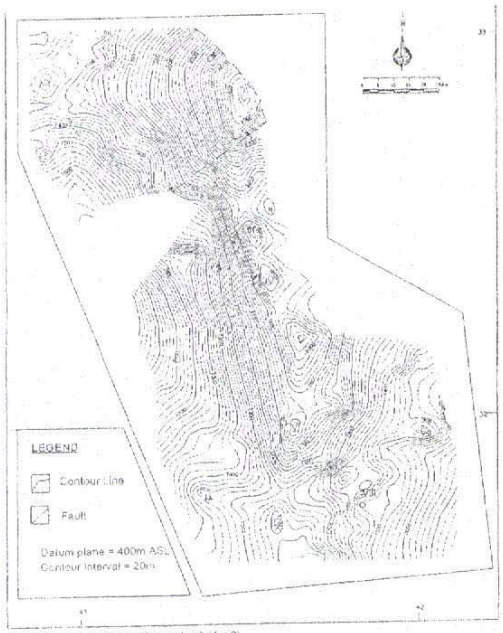
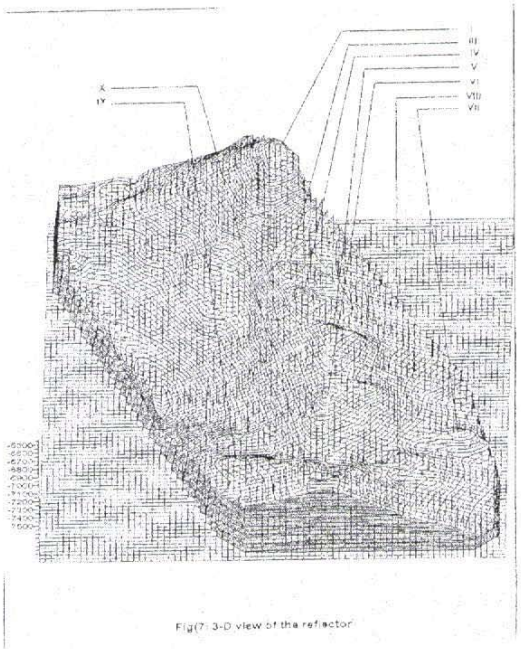


Fig (6) Depth map of the reflector (by Surfer.8)

The middle and southern part of Um-Al-Anz are complex in structural point of view, several anticlineal structures are appeared, they have different closures and dimensions, and they have great importance in possibility of oil and gas existence. Fig(7) shows a 3-dimensional view of the reflector, all the closures have been appeared clearly except No.II is hidden. So we recommend for detail geophysical survey for each one.



Fig(7) 3-D view of the reflector

The table below shows description of those structures:

Table (2) Shows locations and dimensions of the closures.

No	Closure (m)	Dimension (km)	Dimension (km) by (Surfer Ver.8)	Coordinate
I	60	6.7 X 12.5	6.7 X 12.5	32° 48' - 41° 32'
II	40	4.2 X 7.1	4.0 X 6.8	32° 30' - 41° 36'
III	100	8.3 X 10.8	8.1 X 10.5	32° 27' - 41° 34'
IV	100	10 X 13.3	10 X 13.2	32° 20' - 41° 36'
V	120	11.7X 19.9	11.7X 19.9	32° 11' - 41° 41'
VI	60	5.4 X 9.1	5.2 X 9.0	31° 58' - 41° 41'
VII	60	4.2 X 7.5	4.2 X 7.5	31° 57' - 42° 03'
VIII	20	4.2 X 5.8	3.9 X 5.4	31° 50' - 41° 53'
IX	20	1.7 X 4.2	1.6 X 4.3	31° 47' - 41° 25'
X	20	3.2 X 5.8	3.3X 5.9	31° 44' - 41° 36'

The two major deep seated faults have been indicated on the seismic sections of the of Um-Al-Anz area. The first, striking N40W it is a part of Abu-jeer fault, the second, striking N35E represent Umage-Samara-Halabja fault. The position of these two faults is properly coinciding with their positions on the tectonic map of Iraq established by [4].

The depth of the studied reflector, ranges between (6040-7600) m, is less by amount (0.5-2) km from depth of the basement obtained from two different studies at the same area, the first, magnetic map established by France, [14], (C.G.G, 1974) using application of inflection tangent intersection (ITI). The map shows depths of the basement range between (7-10) km, Fig(8). The second study is carried out by, [15], he was determined depths of the basement in a part of Um-Al-Anz range between (7-9) km.

The difference of about (0.5-2) km between the depth of the reflector and basement is appeared which is actually represents the thickness of the limestone bed which covers the basement. This is coincide perfectly with the isopach map of the Cambrian age constructed by [15] in the north and middle part of Um-Al-Anz. He was estimated the thickness of the Cambrian by about (500-2000) m.

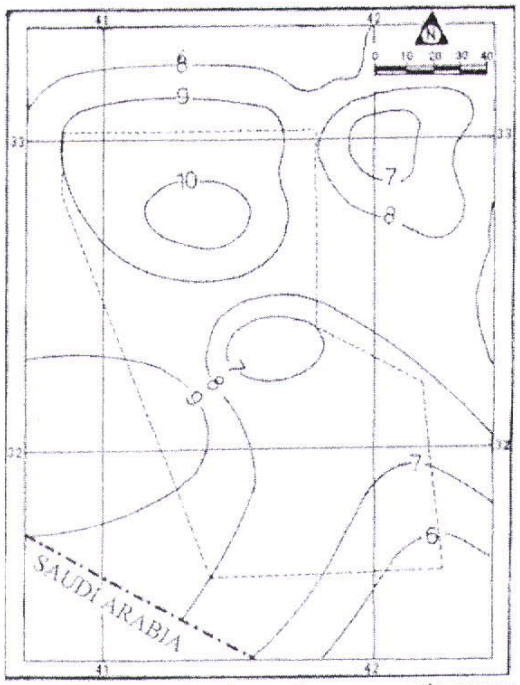


Fig (8) Basement depth map from magnetic survey (by C.G.G, 1974)

Conclusions

1- The studied reflector represent reflection from a limestone bed (Cambrian) has thickness ranges between (500-2000) m covers the crystalline basement.

2- The depths of the reflector range between (6040-7600) m from sea level.

3- The reflector is representing a very large anticline in structural point of view. It has dimension ranges between (130-75) km, striking N40W at north and middle part of the area, changes to N10E in south and southwestern.

4- Several anticlines of different sizes and closures are scattered in the area, they are importance in probability of gas and oil existence. Some of them such as (I, III, IV, V, VI, VII, X) are coincide with those structureal closure present in the tectonic map of Iraq [16], while others such as (I, VIII, X) are not, Fig(2).

5- The locations of a part of the two major faults, Abu-jeer and Umage-Samara-Halabja were picked on the seismic sections and indicated on the both isochron and depth maps, they are perfectly coincide with their locations on the tectonic map of Iraq established by [4].

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