文章编号: 1001—1749(2005)02—0147—03

地质储量计算区块面积确定方法研究

刘吉余, 杨玉华, 于润涛
(大庆石油学院, 黑龙江　大庆　163318)

摘　要: 根据地质储量计算区块边界特征来计算含油面积, 其核心技术是充分利用现有的石油勘探、开发数据库资料, 根据储量计算区块边界各顶点坐标, 由计算机来计算储量计算区块的面积。该方法解决了用求积仪等常规方法求取面积时所存在的精度偏低、操作繁琐、工作量大等缺点, 用这种方法在面积确定过程中自动化程度高, 具有方便、灵活、实用的特点。目前此方法已在生产中进行了推广应用。

关键词: 地质储量; 容积法; 求积仪; 边界; 面积
中图分类号: TE155　　文献标识码: A

0　引言

石油、天然气地质储量是石油和天然气在地下的蕴藏量, 它是油、气田勘探开发成果的综合反映。无论是勘探阶段还是开发阶段, 油气储量一直是石油工作者追寻的主要目标, 是油气田勘探、开发过程中的一项极为重要的工作任务。油气储量是指导油气田勘探、开发, 确定投资规模的重要依据。因此, 石油、天然气地质储量计算的准确与否至关重要。

在油田开发过程中, 常常需要用容积法计算不同区块、不同井组、不同沉积单元的地质储量, 为采取各种开发措施提供地质储量上的依据。容积法地质储量计算参数主要包括含油面积、有效厚度、有效孔隙度、含油饱和度、地面原油密度、原油体积系数等[1,2]。用容积法计算储量的可靠程度, 取决于上述影响因素的数量和质量。随着勘探开发工作的不断深入, 部分油田储量与产量之间的不匹配现象日益突出。对 1984 年以后申报的 56 个油田 94 个断块地质储量复算(容积法)结果统计显示[3], 复算前、后地质储量变化很大, 不同油田的误差范围分布主要集中在 6%～72% 之间。经分析表明, 含油面积对地质储量变化的影响占 35%, 产生误差的原因包括: ① 基础资料不全、不准; ② 由于研究工作不够; ③ 确定参数方法不合理。

对于某一具体储量计算区块, 含油面积是储量计算的首要参数, 对其测定精度的高低, 直接影响到储量计算结果的可靠性。但在实际测定过程中, 一些常见方法往往存在精度偏低、操作繁琐等缺点。为此, 我们对储量计算区块的含油面积确定方法进行了研究, 开发了一套计算储量区块面积的方法, 该方法具有计算速度快、操作简单方便、精度高等优点, 值得进一步推广应用。

1　传统确定地质储量计算区块面积方法简述

传统确定储量计算区块面积的方法有: 在储量计算区块井位图上, 用求积仪法、几何图形法、厘米方格纸法、曲线仪法及称重法来确定含油面积, 其中求积仪法是最常用的一种方法。在实际应用过程中发现, 上述方法均在某种程度上存在精度偏低、计算及操作繁琐等缺点, 而且往往需要用另一种方法进行检查验证。例如, 生产上常用求积仪法来确定地质储量计算区块的面积, 使用时要求用求积仪在两个不同位置上各测一次, 然后取其算术平均值, 并要求每次测定结果与算术平均值之差不大于其值的 1/200(或两次测定结果误差小于 2%)。另

收稿日期: 2004- 09- 24

© 1994-2008 China Academic Journal Electronic Publishing House. All rights reserved.　http://www.cnki.net

外, 此法要求的工作条件很高(如桌面图纸绝对的平整), 操作特别仔细, 否则每次测定结果与算术平均值之差就大于允许误差。用求积仪法确定面积后还需要用几何图形法或别的方法进行检查验证, 操作过程就更加繁琐, 工作量巨大。

2　储量计算区块边界特征

储量计算区块边界特征不外乎有两种, 一是以相带为边界; 另一种是以油(水)井连线为边界, 油(水)井井距之半连线为边界, 或任意点连线为边界。以相带为边界的线是圆滑的弧线, 而以油(水)井连线为边界、油(水)井井距之半连线为边界、或任意点连线为边界的线是折线。储量计算区块面积的确定实际上就是确定圆滑弧线构成的封闭面积或折线构成的多边形面积。

3　储量计算区块面积的计算原理

确定圆滑弧线构成的封闭面积可采用文献[4]所述的方法, 而多边形的面积计算有多种算法, 根据储量计算区块面积特征, 我们采用多边形各顶点坐标的算法来计算其面积。

设有按一定顺序(顺时针或逆时针)排列的 n 个井点 (x_1, y_1)、(x_2, y_2)、……、(x_n, y_n) 围成一个没有交叉的多边形(见图 1), 则该多边形的面积为

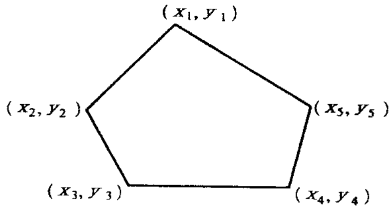

图 1　储量计算区块顶点坐标(五边形)计算面积计算示意图

Fig 1　The sketch map of calculating coordinates of the acmes (pentagon) of the block boundary according to reserves and area

$$|S| = \frac{1}{2}\sum_{i=1}^{n}(x_i y_{i+1} - x_{i+1} y_i) \qquad (1)$$

式中　$x_{n+1} = x_1$; $y_{n+1} = y_1$

多边形各顶点坐标实际上就是井位坐标(油(水)井连线为边界), 两口井的井距之半处坐标(油(水)井井距之半连线为边界), 或任意点处坐标(任意点连线为边界)。

井位坐标是已知的, 两口井井距之半处坐标和任意点处坐标可通过已知的井位坐标计算, 并通过实际坐标系统与屏幕坐标系统进行相互转换。主要代码如下

```
int m_nViewWidth; //视图区宽度
int m_nViewHeight; //视图区高度
int m_nCurViewOrgX; //当前可视范围的原点 X
int m_nCurViewOrgY; //当前可视范围的原点 Y
int m_nCurViewExtX; //当前可视范围终止 X
int m_nCurViewExtY; //当前可视范围终止 Y
//初始化图纸
void CTriAreaDoc::IniPaper(CRect rect)
{
    m_nViewWidth= rect.Width();
    m_nViewHeight= rect.Height();
}
//实际坐标转换到视图坐标
void CTriAreaDoc::WorldToView (CPoint& point)
{
    point.x= m_nViewWidth* (point.x- m_nCurViewOrgX )/( m_nCurViewExtX - m_nCurViewOrgX);
    point.y= m_nViewHeight* (point.y- m_nCurViewOrgY )/(m_nCurViewExtY - m_nCurViewOrgY);
    point.y= m_nViewHeight- point.y;
}
//视图坐标转换到实际坐标
void CTriAreaDoc::ViewToWorld (CPoint & point)
{
    point.x = m_nCurViewOrgX + (m_nCurViewExtX- m_nCurViewOrgX)* point.x/m_nViewWidth;
    point.y= m_nViewHeight-point.y;
    point.y = m_nCurViewOrgY + (m_nCurViewExtY- m_nCurViewOrgY)* point.y/m_nViewHeight;
}
```

© 1994-2008 China Academic Journal Electronic Publishing House. All rights reserved.　http://www.cnki.net

4　地质储量计算区块面积的计算软件

根据地质储量计算区块边界特征及任意面积的计算原理，我们研制了地质储量计算区块面积的计算系统。该系统是在Windows 2000 环境下，采用Microsoft Visual C++ 6.0 开发，系统流程及界面如图所示（见图 2、图 3）。

5　应用结果及效果分析

储量计算区块面积的计算系统开发完成以后，在大庆某油田北一二排西 SⅡ10- SⅢ10 组“上返方案”储量的精细计算中进行了应用。

北一二排西 SⅡ10- SⅢ10 组在垂向上共分 20 个沉积单元，平面上划分了 86 个不规则小区块，分不同厚度等级、不同沉积单元计算地质储量。同时，在北一二排西 SⅡ10- SⅢ10 组“上返方案”设计 87 个井组储量计算中进行了应用。结果表明，该方法具有精度高、操作简单、方便等特点，提高工作效率达 30 倍以上，完全可以取代传统的面积计算方法（求积仪法、几何图形法、厘米方格纸法、曲线仪法、称重法等）。目前该方法已在生产中进行了推广应用。

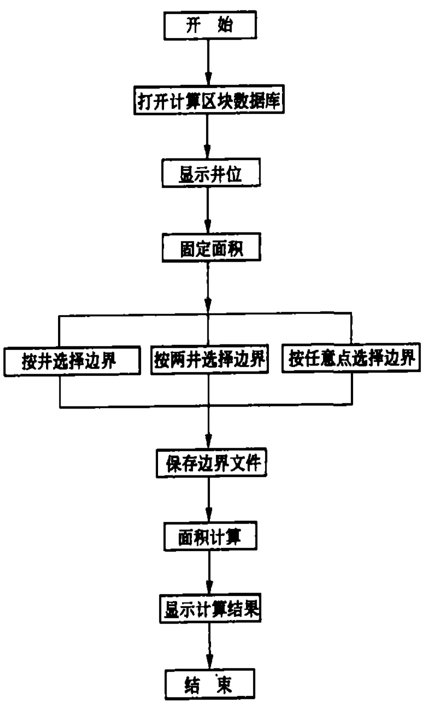

图 2　地质储量计算区块面积确定流程图

Fig. 2　The flow chart of geologic reserve calculation and block area definition

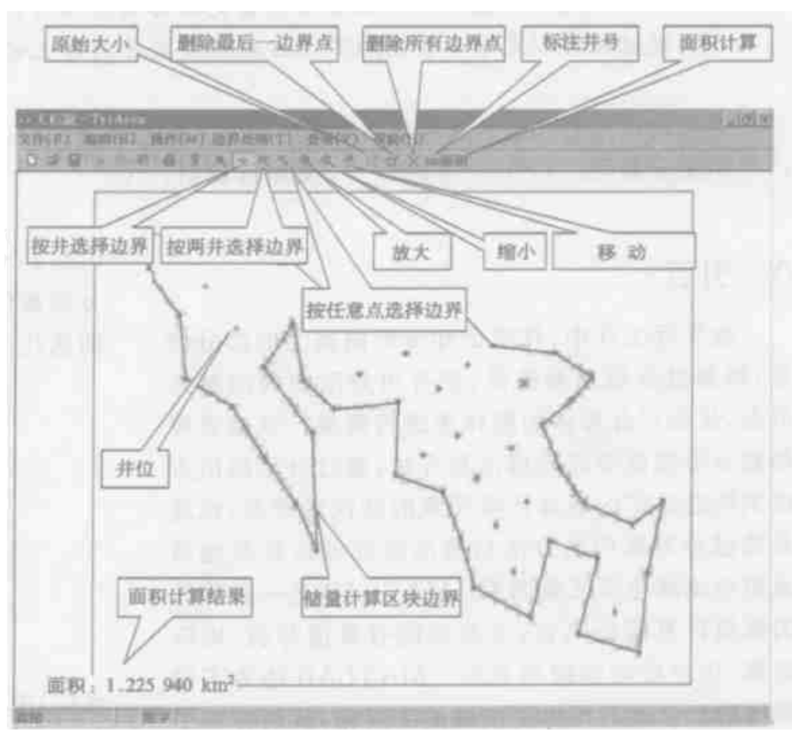

图 3　地质储量计算区块面积计算系统常用工具及某一区块计算结果

Fig. 3　The common tools of geologic reserves calculation and block area system and calculating result of a certain block

参考文献：

[1]　黎文清，李世安．油气田开发地质基础（第二版）[M]．北京：石油工业出版社，1993．

[2]　吴元燕，陈碧珏．油矿地质学（第二版）[M]．北京：石油工业出版社，1996．

[3]　萧德铭，毕海滨．利用油基泥浆取心资料确定砂岩油藏原始含油饱和度若干问题探讨[J]．中国海上油气（地质），2003，17(4)：252．

[4]　刘吉余，许洪东，王长生，等．任意面积储量计算方法研究[J]．物探化探计算技术，2003，25(1)：75．

作者简介：刘吉余（1961- ），男，博士，副教授，主要从事石油开发、地质、油气资源定量化方面的研究。

© 1994-2008 China Academic Journal Electronic Publishing House. All rights reserved.　http://www.cnki.net

EXPLORATION, 2005, 27(2): 0141

By analyzing the accessory element such as Mn, Sr, Mg, etc, and isotope such as ^{13}C, ^{18}O, $^{87}Sr/^{86}Sr$ etc, the authors consider that the most important mechanism of the carbonate reservoir of Lower Paleozoic are dolomitization and karstification. The reservoirs of Yeli- Liang jianshan formation are valuable in ZhuangHai zone and theirs formation was mainly concerned with dolomitizatin during the buried processing, especially concerned with the volume contraction of grains, and they mainly distributed in diagenetic dolomites. The marine carbonate near the unconformity was mainly reconstructed by strong atmogenic freshwater during the Indo - China and Yanshan Movement, being better reservoir. The reconstructed records behave as following: the ratio for $^{87}Sr/^{86}Sr$ in the different carbonate minerals or structural components is higher than carbonate matrix, while the $\delta^{13}C$ and $\delta^{18}O$ value in mass of samples in the different carbonate minerals or structural components are lower than carbonate matrix. The geochemical section of single well shows that the depth influenced by atmogenic freshwater is about 150 meter which is under the Caledonian affiliation plane of the unconformity and at the same time, the freshwater reconstructed the dolomite reservoir which had existed before the former.

Key words: karstification; dolomitization; forming mechanism; carbonate; zhuanghai zone; jiyang sag

RESEARCH OF THE CALCULATING METHOD OF GEOLOGIC RESERVES AND DEFINING BLOCK AREA

Liu Ji-yu, YANG Yu-hua, YU Run-tao (Daqing Petroleum Institute, Daqing Heilongjiang 163318, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2005, 27(2): 0147

The paper mainly discusses a method of calculating oil- bearing area based on block boundary characters calculated by geological reserves. The key technique of the method is to make full use of the information from the present oil prospecting and exploitation database and to calculate the coordinates of the acmes of the block boundary according to reserves and block area and reserves with computer.

The method resolved the defects caused by common methods with planimeter on calculating area, which produce low precision and require complicated operations and much workload. The method with high automation degree in the course of defining area has been widely used and spread in production at present for its convenience, flexibility and practice.

Key words: reserves; volumetric method; planimeter; boundary; area

THE ACHIEVEMENT OF THE L'TH IMPEND OF FRACTAL INTERPOLATED SURFACE OF CHEMISTRY ELEMENT IN ORE BELT USING MATLAB

NI Xiu-jing, LI Jian, HAN Ze-hua (School of information administration, Chengdu University of Technology, Chengdu 610059, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2005, 27(2): 0150

Many problems of geosciences are very complicated, non-linearity and irregular and they may have better solution if non-linearity sciences are used for them. This paper introduces the interpolation function for fractal interpolated surface and discusses the realization about chemistry element's L'th impend of fractal interpolated surface and the algorithms with MATLAB. Based on the algorithm and the MATLAB procedure, the fractal interpolated surfaces are created according to chemistry element data in practical ore belt-ore area of Gegonglong of Gongjue county of Xizang (Tibet) Autonomous Region. From the procedure of achievement, we can fully realize the convenience and high-efficiency of MATLAB in solving practical problems.

Key words: fractal geometry; fractal interpolated surface; MATLAB

A MULTI-MAP SYSTEMIC ERROR CORRECTION METHOD BASED ON BORDER LIMITING PRINCIPLE

JI Hong-jin, SHI Yan-xiang, DAI Yong-gang, HAO Li-bo, LU Ji-long (College of Geo-Exploration Science and Technology, Jilin University, Changchun 130026, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2005, 27 (2): 0154

To solve the problem about multi- map systemic error correction in regional geochemical exploration, a computing method based on the least squares methods is developed. The basic theorem is the border limiting principle developed in partition standardization method. It also shows that the method is a extension of partition standardization method, and its correction result is the same as latter in the case of two maps.

Key words: geochemical map; systemic error; correction; border limiting principle

© 1994-2008 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net