中国碎屑岩储集层的孔隙结构

邱世祥 等著

西北大学出版社

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Pore Textures in Clastic Reservoirs of China

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内 容 简 介

本书是一部研究我国主要含油气盆地碎屑岩储集层孔隙结构特征的学术专著，内容包括储集层的孔隙类型、孔隙结构级别、特征及成因。书中以精选的 630 幅具有代表性的有关这些方面的彩照、电镜照片、阴极发光照片为主体，配有详细的图版说明，反映作者的学术思想，同时还有简洁的文字，综述了我国各主要含油气盆地碎屑岩储集层孔隙结构特征。全书内容丰富，照片珍贵，学术见解新颖，实为我国第一本比较全面系统论述我国碎屑岩储集层孔隙结构的学术著作。对从事石油地质及油田开发的教学、科研与生产人员均有重要参考价值。

Synopsis

This book presents a summary of studies on porosity texture in clastic reserviors of the major oil–and gas–bearing fields of China. Among the main topics treated are types, grades and characteristics of porosity and origin of pore textures. Apart from a brief bilingual written account in Chinese and English, the main contents of the book include a select collection of 630 color photographs, SEM and cathodeluminescence photomicrographs as well as illustrations presented to depict the authors′ views. The whole book contains abundant information and valuable photographs and includes new approaches to classification of porosity types and pore textural grades as well as a concise synthesis of characteristics of pore texture in clastic reservoirs of the major hydrocarbon–bearing basins of China. As the first comprehensive and systematic treatise on pore texture in clastic reserviors of China, it should prove a greatly useful source of reference for teachers, researchers as well as specialists working in the field of petroleum geology and oil exploitation.

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前　言

储集层是油气藏形成不可缺少的条件之一，历来都是油气勘探与开发工作中十分重要的研究课题。通常人们把储集层分为碎屑岩、碳酸盐岩及其他岩类等三种不同的类型，其中碎屑岩储集层分布最广，也最重要。目前世界上许多大油气田，如苏联西伯利亚盆地的各主要油气田（乌连戈伊、亚姆堡等特大气田，萨莫特洛尔等大油田）、科威特的布尔甘油田、委内瑞拉的波利瓦尔湖岸油田、美国的普鲁德霍湾油田、荷兰的格罗宁根气田等的储集层都是这种类型。在我国，除华北（任丘）、四川盆地的一些油气田及已经出油、出气的塔里木与鄂尔多斯盆地油气区有碳酸盐岩储集层外，其余油气田的主要储集层都是碎屑岩储集层。因而对此类储集层进行研究，不仅直接与找油、找气及油气田的合理开发密切相关，并且对探索和认识油气藏形成与分布的规律以及丰富和发展石油地质理论具有重要意义。

1985年，我们承担了“中国碎屑岩储集层的孔隙结构、成岩作用及油气运移”的国家自然科学基金项目。在孔隙结构的研究中，我们从全国各主要油气田采集了5000多个样品进行了观测，并从微观的角度研究了碎屑岩储集层的主要孔隙类型、孔隙结构级别和主要特征以及成因，最后在我们的研究成果基础上参考了前人所做的工作，精选出了630幅照片和有关的图件，并附以简明扼要的文字说明，编撰了这本文、图并茂的《中国碎屑岩储集层的孔隙结构》。

这部著作是上述研究课题的成果之一，可以说是从微观角度对中国碎屑岩储集层孔隙结构的总结，读者纵览全书后，我们相信可以从以下三个方面得到启迪：

1. **孔隙分类**　我们以容易识别和在储集层评价中比较适用为主要原则，提出了以孔隙产状为主，同时考虑溶蚀作用的分类方案，将储集层孔隙划分为八类，并以典型照片具体展示了各类孔隙的产状等特征。这将有助于在实际工作中识别孔隙类型和判断储集层的好坏。

2. **孔隙结构级别**　储集层中各类孔隙与之间连通喉道的组合，即孔隙和喉道发育总貌，统称为孔隙结构。孔隙结构的好坏是储集层评价的重要依据。根据

有关参数，本书将储集层孔隙结构划分为三级六亚级，同样以典型照片和图件指明了每个级别的主要孔隙结构特征。它们对进行储集层评价有一定参考价值。在这一部分中，我们对各级储集层，特别是低渗透储集层中的溶蚀孔隙选的照片比较多，目的是引起大家重视对此类孔隙及其发育规律的研究，以促进目前我国的油气勘探，尤其是深部油气勘探。

3. **孔隙结构的成因** 储集层目前的孔隙结构，是原始孔隙结构经过成岩作用改造所成。成岩演化受岩石原始矿物成分和结构的明显影响，而后者又主要受沉积作用控制。因此，对储集层孔隙结构成因的探讨，主要应考虑沉积(包括岩性、岩相)与成岩作用两种因素。本书重点从后一因素角度以照片和图件的形式进行了阐述。有关前一因素的内容，涉及的比较少，将放在本课题的另一本著作中讨论。

本书在照片与图件的版式设计上，原拟以能更好的说明孔隙结构及其成因为原则，将铸体薄片照片、电镜扫描照片及压汞曲线图有机地插放一起。后因某些难以克服的客观原因只好分三部分编排。为了弥补其不足，我们在照片的文字说明中作了补充。

参加本项研究工作的有邸世祥、祝总祺、曲志浩、陈景维、卢焕勇、柳益群、张金功及白玉润等同志。本图册由邸世祥主编，在编撰过程中，全文由邸世祥撰写，卢焕勇、柳益群与张金功做了大量工作。正文与图版说明的翻译分别由李桃红与柳益群完成。研究工作中，曾得到石油勘探开发研究院北京总院与廊坊分院、各油田研究院、地矿部第三石油普查大队、地矿部无锡中心实验室及西北大学测试中心与地质系等单位的大力协助，它们除承担了有关分析测试任务外，其中一些单位还提供了部分样品和有关资料，对我们完成本课题起了很大作用。这里特别要提到的是杨万里、叶得泉、邢顺诠、李忠荣、任积文、王秉海、王捷、郑长明、吴涛、李道品、严衡文、马忠义、杨俊杰、朱义吾、黄月明、张绍平、徐世荣、杨学庸、刘庆国、高玉荣、曹建康、靳仰廉、雍天寿、蒋显庭、王国民、车卓吾、赵春元、任健、朱家蔚、邸世祺、杨效成、谢秋元、周麒声、周焕民、张复礼、王希仁、李壁祺及惠超英等许多同志，在工作中对我们的帮助更多，其中严衡文、王希仁、李壁祺、曹建康、张绍平等同志还直接参加了部分研

究工作，提供了部分珍贵照片。另外，在编撰过程中，西北大学地质系绘图室的刘仰枢、骆正乾、郭旗、照相室的李立宏和石油地质教研室的苗建宇等同志也做了较多工作。在此，特对上述单位和同志们表示衷心的感谢。

限于水平及实际工作主要是在西北及河南省一些含油气盆地中，因此，书中肯定有不完善甚至错误之处，敬请读者提出补充与修正意见。

邸世祥

1989.12

说明和缩写字:

1. 文中括号内的数字（如 **2**，**3**，**61–66**）为照片及毛管压力曲线图编号
2. 照片英文说明中的字母

XN–正交偏光
SEM–电镜扫描
CL–阴极发光

Preface

The study of reservoirs as one of the essential conditions for the formation of hydrocarbon accumulations has long been the subject of great importance to both the hydrocarbon explorationist and exploitationist. Reservoir rocks are generally divided into clastic, carbonate and other rock types, among which clastic reservoirs are the most abundant and important. Many of the major hydrocarbon reservoirs so far recognized in the world belong to this type, as for instance the major fields in the west Siberian basin of the Soviet Union (the giant gas fields of Urengoy and Yambuer and the large oil field of Samotror), the Burgan field in Kuwait, the Bolivar coastal field in Venezuela, the Brudhoe Bay field in the U. S. and the Groninger field in the Netherlands. In China, the major hydrocarbon reservoirs are also of the clastic type, except for some fields in North China (the Renqiu field) and in the Sichuan Basin, and the oil and gas producing areas in the Tarimu and Ordos Basins, where carbonate reservoirs are found instead. Thus, the study of clastic reservoirs is not only directly relevant to the exploration for oil and gas and their effective development, but is also important in enriching and enhancing the theories of petroleum geology concerning the formation and occurrence patterns of hydrocarbon accumulations.

Extensive studies have been done and are still being done on reservoirs from different view points of the explorationist and exploitationist using multiple methods including both megascopic and microscopic analysis. This book presents some of the results we obtained in undertaking the research project entitled ″ Pore Texture, Diagenesis and Hydrocarbon Migration in Clastic Reservoirs of China″ funded by a grant from the National Natural Science Foundation of China. It gives a summary of porosity texture in clastic reservoirs of China from a microscopic standpoint. Included are three separate sections: (1) Principal porosity types in clastic reservoirs; (2) Grades and chief characteristics of pore textures in clastic reservoirs and (3) Origin of pore textures in clastic reservoirs. Although each section embodies a brief written account, the leading objective is to express our views by means of photographs and illustrations. Thus the main contents of this atlas comprize some 630 photographs and illustrations selected from our first–hand studies of a large number of oil and gas fields, including in particular the results of examination of more than 5000 samples from the major oil and gas fields of China as well as those of our predecessors that are relevant to the subject. Looking through these photographs and illustrations, the reader may note the following features of this book:

1. According to the principle that the ideal classification for porosity should be one that not only defines the porosity type clearly but also proves applicable to use in the appraisal of reservoirs, we have proposed a classification scheme that recognizes 8 porosity types based primarily on the mode of occurrence of porosity and at the same time taking dissolution features into consideration. Characteristics of these different porosity types such as their mode of occurrence are illustrated by means of representative photographs. This undoubtedly will be of great value in practical use in helping to distinguish different porosity types and appraise quality of reservoirs.

2. The sum of all geometric aspects and the arrangement of various types of pores as well as pore throats connecting them in reservoir rocks, i. e. the general physical appearance of occurrence of pores and pore throats, is defined in this book as pore texture. The quality of pore textures is an important criterion for evaluation of reservoir quality. According to certain variables, pore textures are classified in this book into 3 grades which in turn are divided into 6 sub-grades. The main charateristics of these pore textural grades are at the same time illustrated by means of typical photographs and illustrations. They will prove a useful source of reference for evaluation of reservoir quality. A considerable number of photographs are included in this part with regard to reservoirs of different textural grade and especially to dissolution porosity in low-permeability reservoirs. It is hoped that great emphasis will be placed on this type of porosity and its development patterns so as to further exploration for hydrocarbons in China, especially in hydrocarbon exploration at deep levels.

3. The present textures of porosity of reservoir rocks are doubtless the result of modification of primary pore textures by diagenetic processes. It is known that diagenetic changes are strongly affected by the original mineral content and texture of the rock which in turn are governed dominantly by the process of deposition. The factors of deposition (lithology and facies) and diagenesis are therefore the two major concerns in the inquiry into the origin of textures of reservoir porosity. This book is primarily concerned with diagenetic processes and gives an account of their influence in the form of photographs and illustrations, whereas the factor of deposition will not be extensively discussed; data bearing on this aspect are intended to be presented in a separate book on the same subject of this research.

The photographs and illustrations were initially intended to be arranged organically in a whole so as to illustrate more effectively the character and origin of porosity textures. Later, as the cost of inserting color photographs betweem SEM micrographs proved markedly higher in the course of composition of type, an arrangement of the two kinds of photographs each in three parts had to be adopted instead. To compensate for this defect, correlation is made as far as space permits in the captions of photographs.

The participants in this research project are Di Shixiang, Zhu Zongqi, Qu Zhihao, Chen Jingwei, Lu Huanyong, Liu Yiqun, Zhang Jingong and Bai Yirun. Di Shixiang is the chief editor. Thanks are in particular due to Lu Huanyong, Liu Yiqun and Zhang Jingong Who assisted with so many practical matters in the compilation of the book. We also acknowledge Li Taohong and Liu Yiqun for the translating of the manuscript and illustration captions into English respectively. In undertaking this research, we have also received generous help from the Beijing Scientific Reserch Institute of Petroleum Exploration and Development and its division at Langfang, the Research Institutes of the various oil fields, the 3rd Petroleum Geological Surveying Brigade of the Ministry of Geology and Mineral Resources, the Wuxi Central Laboratory of Petroleum Geology of the Ministry of Geology and Mineral Resources, and the Analysis Centre and the Department of Geology of Northwest University. They carried out the analyses and some of them even provided samples and data, which contributed considerably to the completion of this research. In particular, we acknowledge with thanks Yang Wanli, Ye Dequan, Xing Shunquan, Li Zhongrong, Ren Jiwen, Wang Binghai, Wang Jie, Zheng Changming, Wu Tao, Li Daopin, Yan Hengwen, Ma Zhongyi, Yang Junjie, Zhu Yiwu, Huang Yueming, Zhang Shaoping, Xu Shirong, Yang Xueyong, Liu Qingguo, Gao Yurong, Cao Jiankang, Jin Yanglian, Yong Tianshou, Jiang Xianting, Wang Guomin, Che Zuowu, Zhao Chunyuan, Ren Jian, Zhu Jiawei, Di Shiqi, Yang Xiaocheng, Xie Qiuyuan, Zhou Qisheng, Zhou Huanmin, Zhang Fuli, Wang Xiren, Li Peiqi and Hui Chaoying. These individuals were especially helpful and among them Yan Hengwen, Wang Xiren, Li Peiqi, Cao Jiankang and Zhang Shaoping were even immediately involved in part of the research work and provided valuable photographs. Finally, for their contribution and help in the preparation of this book, we wish to thank Liu Yangshu, Luo Zhengqian and Guo Qi of the Drafting Division, Li Lihong of the Studio, and Miao Jianyu of the Teaching and Research Division of Petroleum Geology, the geological Department of Northwest University.

Di Shixiang

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Illustration and abbreviation:

1. The numbers in brackets (for example: **2, 3, 61–66**) represent the numbers of photographs and figures of capillary pressure curve.
2. The abbreviations in the explanation of photos

XN–Crossed nicols
SEM–Scanning electron microscope
CL–Cathodoluminescence

目　录

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第一部分　碎屑岩储集层的主要孔隙类型

关于孔隙类型的划分，前人从不同角度曾提出过很多方案。归纳起来，大致有三类：

1. 着重从孔隙成因的地质意义出发，把孔隙分为原生、次生及混合成因三大类，每一类型又进一步细分为若干次一级类型。这是目前国内外比较流行的一种分类，如 V · Schmidt 等的分类。

2. 按孔隙直径的量值进行的分类，如一般石油地质教科书上经常提到的超毛管孔隙（孔隙直径大于 500μm）、毛管孔隙（孔隙直径 500–0.2μm）及微毛管孔隙（孔隙直径小于 0.2μm）。这种分类着重强调了孔隙几何形状对渗流作用的物理意义。

3. 既考虑成因又考虑孔隙几何形状的分类。E. D. Pittman 的分类就属这种类型。他把孔隙分为粒间孔隙、溶蚀孔隙、微孔隙及裂缝孔隙四种类型。显然其中微孔隙是按孔隙大小划分的，其他则是从成因的角度。

根据我们对大量碎屑岩储集层铸体薄片与电镜扫描的观测，深感上述方案虽都有各自的分类依据，理论上似乎也都可以区分开来，但实际判别仍有许多困难。因此，我们提出了以孔隙产状为主并考虑溶蚀作用的划分方案，即按产状把孔隙分为四种基本类型，又从溶蚀作用角度相应地分出了四种溶蚀类型。以上八种类型的名称分别为**粒间孔隙**、**粒内孔隙**、**填隙物内孔隙**、**裂缝孔隙**及**溶蚀粒间孔隙**、**溶蚀粒内孔隙**、**溶蚀填隙物内孔隙**、**溶蚀裂缝孔隙**。后四类孔隙是在前四类孔隙基础上发育起来的，是前四类孔隙受到溶蚀改造，并保留有溶蚀痕迹的孔隙。

上述八类孔隙的划分并不是从成因角度出发的，而只是考虑到溶蚀作用在改造原生孔隙和早期所形成的次生孔隙方面的重要作用。经过这种溶蚀改造的孔隙，不仅使储集层孔隙结构得到明显改善，而且由于其形成时期往往与有机质向油气转化的时期能协调配合，可能对油气运移和聚集十分有利。因此，在划分四种基本类型孔隙的基础上，相应地又划分出了四种溶蚀类型孔隙。我们并不认为四种基本类型孔隙都是原生孔隙。事实上其中的自生粘土矿物填隙物内晶间孔隙和裂缝孔隙等主要还是次生的。后四种类型孔隙虽都不同程度遭受过溶蚀改造，但严格说来，把它们都叫次生孔隙，也是不完全恰当的。因为它们中的很大一部分是在原生孔隙基础上发育起来的，而且目前单个孔隙中大都包含有原生孔隙的

剩余部分，确切地说，他们只能是原生与次生孔隙的组合。

我们之所以把孔隙分为这样八种类型的理由是：第一，在实际工作中容易识别。如有些粒间孔隙几乎全部在早成岩及中成岩的未成熟与半成熟期被方解石充填胶结，中成岩成熟期 A，这些胶结物又被强烈溶解，但颗粒却未受到任何损害，因而孔隙中看不到任何溶蚀痕迹。若按 V · Schmidt 等的成因分类，它应属次生孔隙，即所谓的次生粒间孔隙，但在实际工作中，却很难把它与一般原生粒间孔隙加以区分。而按我们的分类，则很容易地将它归入粒间孔隙类型。第二，在储集层评价中比较适用，如本方案分出的粒间孔隙和溶蚀粒间孔隙，个体都比较大（直径一般 $>50\mu m$，甚至达数百个 μm 量值），彼此连通性好，孔隙度、渗透率都比较高，好的储集层一般主要发育这两种类型的孔隙。粒内孔隙和溶蚀粒内孔隙，比较常见的还是后者，如沿长石解理溶蚀扩大形成的串珠状溶蚀粒内孔隙及岩屑颗粒中易溶矿物溶蚀后所形成的蜂窝状溶蚀粒内孔隙等。这两类孔隙虽然个体直径比较大，但由于受溶蚀颗粒零星分布的制约，在岩石中常呈团粒状散布，因而此类孔隙之间及它们与其它类型孔隙之间的连通性一般都较差。通常以这两种类型孔隙为主的储集层，其储集条件大都比较差。填隙物内孔隙和溶蚀填隙物内孔隙，常见的是前者，这两类孔隙大都是充填在粒间孔隙及溶蚀粒间孔隙中的填隙物本身所具有的细小孔隙。它们可以是自生粘土矿物晶体之间的孔隙和陆源粘土杂基中的微孔隙，也可以是填隙物局部被溶而形成的细小溶蚀孔隙（如沸石与碳酸盐填隙物内的溶蚀孔隙）。这两类孔隙的特点是，因填隙物呈团块状分布而成块状群体，孔隙个体十分细小（一般孔隙直径在 1–10μm），连通性很差。显然，以这两类孔隙为主的储集层，其储集条件应是最差的。裂缝及溶蚀裂缝两类孔隙，常起因于构造断裂，或在构造作用基础上又遭受溶蚀改造所成，主要起着沟通孔隙的作用。由上可见，根据储集层铸体薄片所观察到的主要孔隙类型，就可基本评价该储集层储集性能的好坏。

上述八种孔隙类型的产状如图 1 所示，其主要特征如下：

粒间孔隙 —— 指储集岩碎屑颗粒之间的孔隙。以其中充填杂基及胶结物的多少，进一步分为完整粒间孔隙，剩余粒间孔隙及缝状粒间孔隙三小类。完整粒间孔隙是指粒间孔隙中基本无填隙物（1、59、60），剩余粒间孔隙是指粒间孔隙中有部分填隙物（2、3、61–66），缝状粒间孔隙是指粒间孔隙基本被填隙物充填，只剩余一些缝隙（4、67–72）。粒间孔隙的共同特点是，不论颗粒、填隙物或孔隙均看不到溶蚀迹象。

粒内孔隙 —— 指碎屑颗粒内部不具溶蚀痕迹的孔隙，如喷发岩岩屑所具有的气孔（5–8、73、74）。这类孔隙在碎屑岩中比较少见，大都是孤立或基本不

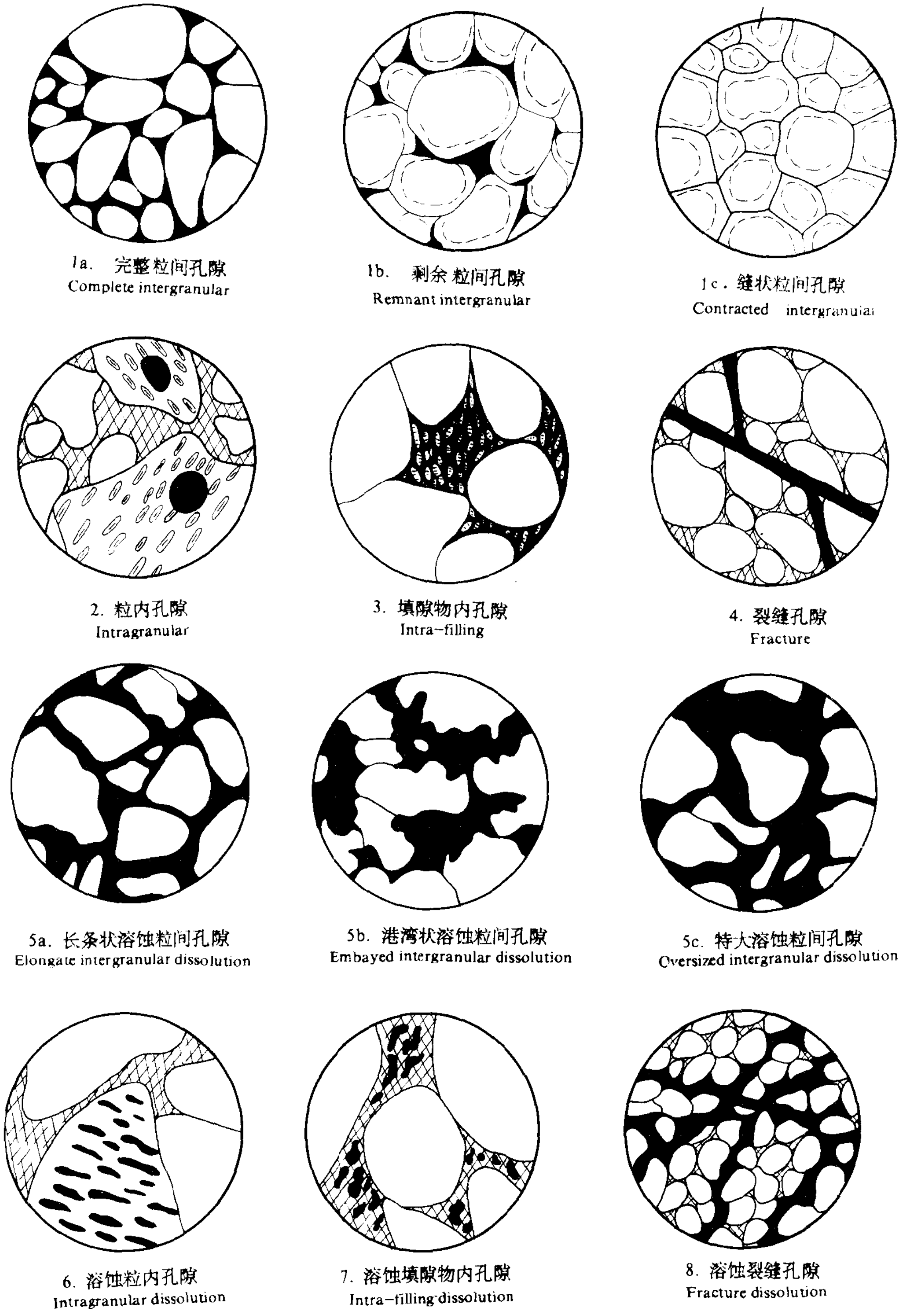

图1 孔隙类型示意图 Types of porosity

连通的。因而对油气的聚集往往作用不大。

填隙物内孔隙 —— 指杂基和胶结物内存在的孔隙。这类孔隙分布比较普遍，特别是自生粘土矿物填隙物内的晶间孔隙，在所有碎屑岩储集层中几乎都存在，只是含量不等（9–13、75–101）。填隙物内孔隙一般都是小孔隙，但由于其中的杂基与自生矿物的成分、晶粒大小仍有不同，故所含孔隙也有相对大小之分，如高岭石填隙物内晶间孔隙一般比伊利石和绿泥石填隙物内晶间孔隙要大一些，粗晶高岭石填隙物内晶间孔隙比细晶高岭石填隙物内晶间孔隙也要大些。

裂缝孔隙 —— 指切穿岩石，甚至切穿其中碎屑颗粒本身的缝隙。一般缝壁平直，无任何溶蚀迹象存在（14、15、102、103）。

溶蚀粒间孔隙 —— 是粒间孔隙遭受溶蚀后所形成的孔隙。这类孔隙除处在碎屑颗粒之间外，从孔隙周边形态、相邻颗粒表面特征、孔隙中残留填隙物的产状和(或)孔隙分布状况等方面，程度不同地保留溶蚀痕迹(16–34、104–115)。这类孔隙根据溶蚀部位及程度的不同，进一步可分为部分溶蚀粒间孔隙，印模溶蚀粒间孔隙、港湾状溶蚀粒间孔隙、长条状溶蚀粒间孔隙及特大溶蚀粒间孔隙等。

部分溶蚀粒间孔隙是指粒间孔隙周围的颗粒，部分被溶蚀并保留有溶蚀痕迹者，或粒间孔隙内的填隙物部分被溶解而残留其团块者。有些溶蚀粒间孔隙，虽然从单个孔隙及其中的填隙物或（和）周围颗粒上看不到溶蚀痕迹，但从岩石整体看，孔隙的发育很不均匀，若非溶蚀所致是不太好理解的。这有两种情况，一是碎屑颗粒松散排列具有大量粒间孔隙的部分与颗粒紧密排列基本无孔隙的部分相邻。此种情况说明该岩石的原有可溶性填隙物的分布是不均匀的，在压实成岩过程中，不含填隙物的部分被紧密压实，颗粒几乎成镶嵌状，而相邻含可溶性填隙物的部分，先因填隙物的支撑颗粒未被压紧，后由于填隙物的被溶才具有较多粒间孔隙。二是岩石中原有填隙物虽然均匀分布，但之后仅有一部分填隙物被溶，具有发育的粒间孔隙，而相邻部分未受溶蚀，粒间孔隙基本不存在。当然，此种粒间孔隙的不均匀分布，也有可能是成岩过程中可溶性填隙物不均匀充填所致。实践证明，鉴别第二种情况粒间孔隙不均匀分布的真正成因时，应结合观察其他溶蚀标志，若有溶蚀标志存在，则可确定为溶蚀成因，否则将是不均匀充填所致。印模溶蚀粒间孔隙是指一些碎屑颗粒或（和）填隙物晶粒被溶去而残留的印模孔隙。港湾状溶蚀粒间孔隙是指碎屑颗粒或（和）填隙物被溶蚀成港湾状的粒间孔隙。长条状溶蚀粒间孔隙，是相邻粒间孔隙之间的喉道同时受到溶蚀，致使两个，甚至多个粒间孔隙连成长条状孔隙者。特大溶蚀粒间孔隙是指岩石受到了强烈的溶蚀作用，致使一个，甚至几个碎屑颗粒与其周围的填隙物都被溶掉而

形成的超粒特大孔隙。显然，从部分溶蚀粒间孔隙、长条状溶蚀粒间孔隙至特大溶蚀粒间孔隙，溶蚀作用的强度是逐渐增大的。

溶蚀粒内孔隙——指碎屑颗粒内部所含可溶矿物被溶，或沿颗粒解理等易溶部位发生溶解而成的孔隙。其特点是孔隙不仅处在颗粒内部，而且数量比较多，往往成蜂窝或串珠状（35－49、116－146）。如前所述，与粒内孔隙相比，在岩石中此类孔隙更发育些，常见的是长石溶蚀粒内孔隙与岩屑溶蚀粒内孔隙。

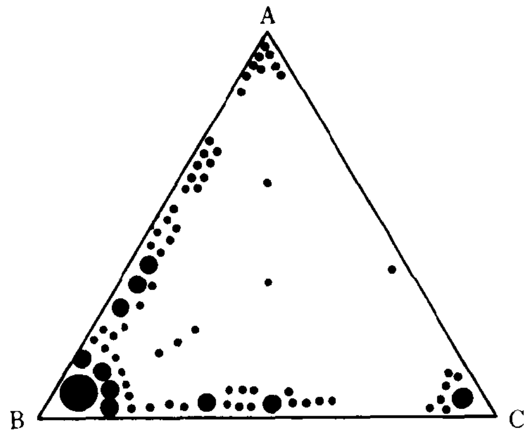

图 2　孔隙主要类型三角统计图

图中：⬤ ● • 分别代表 1 个，10 个，100 个样品数

A 点—100%含粒间孔隙及溶蚀粒间孔隙；

B 点--100%含填隙物内、溶蚀粒内、溶蚀填隙物内及粒内孔隙；

C 点—100%含溶蚀裂缝及裂缝孔隙.

Fig. 2　Triangular statistics diagram of major porosity classes.

⬤ ● and • are plots for one, 10, and 100 Samples respectively

Point A—porosity with 100 percent of intergranular pores and intergranular dissolution pores

Point B—porosity with 100 peccent of intra-filling, intragranular pores, intrafilling and intragranular dissolution pores.

Point C—porosity with 100 percent of fracture pores and fracture dissolution pores

溶蚀填隙物内孔隙——指填隙物受溶蚀作用所形成的孔隙。由于杂基及自生胶结物晶粒之间的孔隙本身很小，使流体在其中较难通过，溶蚀作用相对比较弱。因此，与填隙物内孔隙相比，它的发育程度大大减低，一般只在可溶填隙物中才比较发育，如沿盐类、沸石等自生矿物晶粒间溶蚀所成的孔隙等（50－54、147－156）。当溶蚀作用强烈发育，使填隙物大量溶去时，此类孔隙即可转变为溶蚀粒间孔隙。

溶蚀裂缝孔隙——是流体沿岩石裂缝渗流，使缝面两侧岩石发生溶蚀所致。由于裂缝形成后一般都将导致流体渗流，相应地大都使孔壁发生溶蚀。因此，此类孔隙比单纯的裂缝孔隙更为常见（55－58、157－162）。