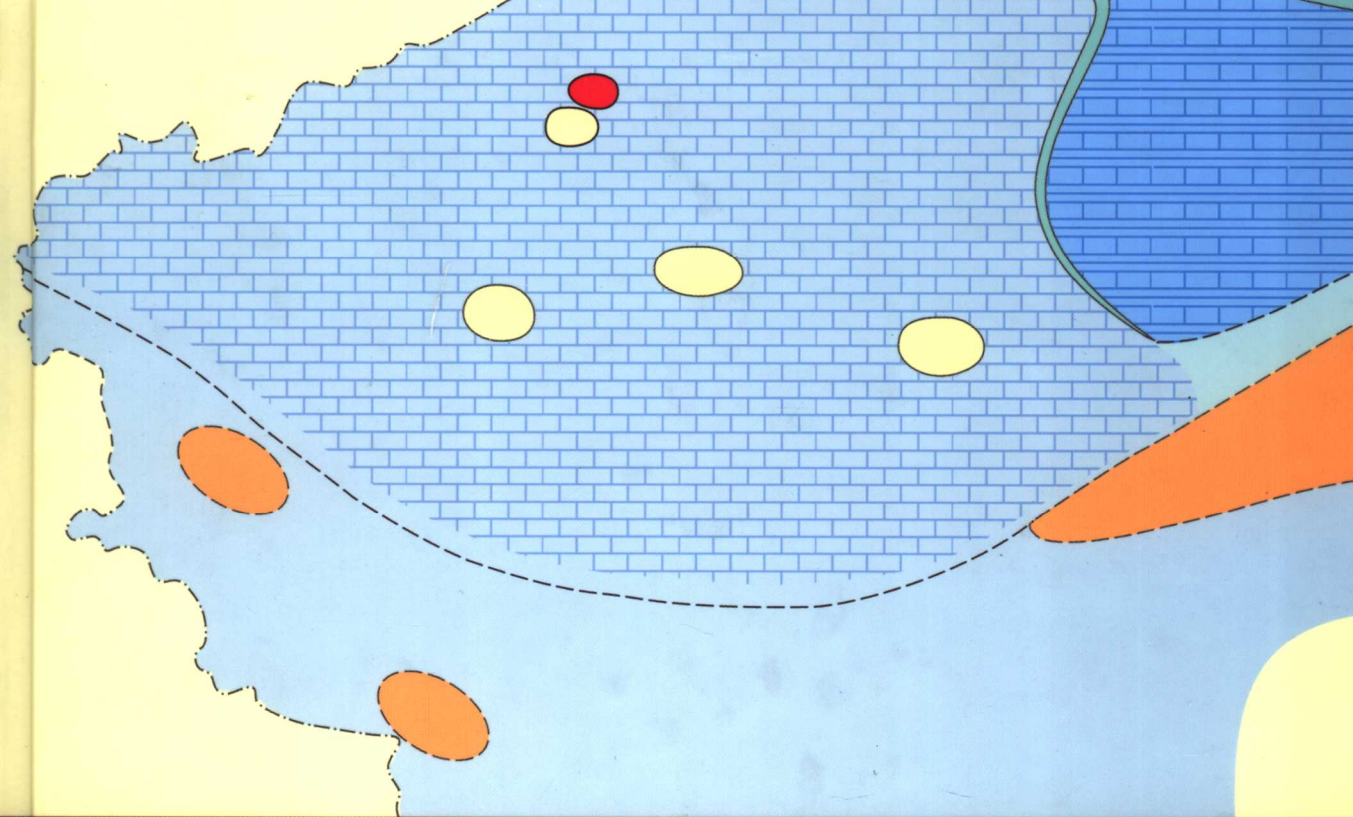




塔里木地区 寒武纪和奥陶纪岩相古地理

冯增昭 鲍志东 吴茂炳 金振奎 时晓章 著

地质出版社

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序

我长期从事华北地区及华南地区古生代海相碳酸盐岩的岩石学及岩相古地理学研究工作，早就想去塔里木地区，对那里的古生代尤其是寒武纪和奥陶纪海相碳酸盐岩作些岩石学和岩相古地理学研究工作，从而对其油气勘探工作提供一些最根本的科学依据。但是，一直没有机会。

2001年，塔里木油田的孙龙德副总经理、油田勘探事业部的田军经理、油田勘探开发研究院的王招明院长请我去地质考察和讲学，我为塔里木油田做点事的机会来了。

在黄智斌高工及杨帆工程师的带领下，我和鲍志东教授去柯坪地区看了那里的寒武纪和奥陶纪剖面，看了天山南麓的中生代剖面，看了前人的一些研究成果，看了岩矿实验室和岩石薄片及照片，还看了塔里木河和沙漠公路等，大开了眼界。有此感性认识，我以华北鄂尔多斯地区及华南地区寒武纪和奥陶纪海相碳酸盐岩岩石学（尤其是白云岩岩石学）和定量岩相古地理学的研究成果^[1~4]为例，与塔里木地区寒武纪和奥陶纪海相碳酸盐岩的岩石学、岩相古地理学研究^[5]及油气勘探工作对比，指出塔里木地区寒武纪和奥陶纪以及整个古生代的岩石学和岩相古地理学的定量研究还相当不够，因此其油气勘探工作就缺乏最基本的地质依据，就难免出现一些缺乏科学依据的乐观，如对奥陶纪生物礁的油气潜景评价过高等。缺乏科学依据的乐观就意味着对确切的油气勘探目标或方向尚未看准。这就是问题的根本。

他们对我这个学术报告还很有兴趣，很快就接受了我的建议，建立了一个“塔里木地区寒武纪和奥陶纪岩相古地理研究及编图”课题，并希尽快开始工作。本来，我建议把塔里木地区整个古生代的定量岩相古地理研究及编图工作一起搞，但他们还是决定先搞寒武纪和奥陶纪的，其他时代的以后再说。我理解他们的这一谨慎态度。

接受任务后，我和鲍志东教授就立刻制定研究计划和组织人力。研究工作于2001年11月正式开始。

经过两年多的努力，于2003年底完成了任务，并通过了验收。

在完成此项科研任务的过程中，大部分的领导和组织工作是鲍志东教授负责的，金振奎教授和吴茂炳博士后也参与了领导和组织工作，日常的研究工作主要由吴茂炳博士后承担，硕士生时晓章、李伟和杨春雨以及博士生张冬玲等也参加研究工作。塔里木油田的孙龙德副总经理、油田勘探事业部的田军经

理、油田勘探开发研究院的王招明院长、王清华副院长、杨文静副所长、黄智斌高工、杨帆工程师、赵治信高工、顾乔元高工、孙玉善高工、张师本高工等给予了热情指导和协助。特此致谢。

在此最终研究成果的基础上,又经过多达十来次的修正,才完成了本书《塔里木地区寒武纪和奥陶纪岩相古地理》的定稿。在此修正和定稿过程中,王永萍同志在打字和修正图件中出了大力。特致谢意。

本研究成果和本书主要采用我倡导的单因素分析多因素综合作图法^[1~6],在对野外露头剖面 and 钻井剖面的定量岩石学研究的基础上,以下寒武统、中寒武统、上寒武统、下奥陶统两河口阶和红花园阶、中奥陶统大湾阶和牯牛潭阶、上奥陶统庙坡阶、上奥陶统宝塔阶、上奥陶统临湘阶和五峰阶等8个作图单位,对塔里木地区寒武纪和奥陶纪进行定量岩相古地理研究及编图,共编出各种单因素图47幅,岩相古地理图8幅;在此基础上,撰写出了相应的文字论述,从而完成了本书。

本来,在本课题的最终研究成果中,还有白云岩及岩溶岩两个专题研究成果;但鉴于其研究工作尚待进一步提高,所以在本书中均删去了。这只有待今后补正了。

对我本人来说,用我倡导并长期使用的方法论即单因素分析多因素综合作图法^[1~6],编制出塔里木地区寒武纪和奥陶纪各作图单位的定量单因素图和岩相古地理图,并撰写出相应的文字论述,并不算什么新鲜事;但对塔里木地区来说,这种定量的岩石学和岩相古地理学研究及编图还是第一次,还是一件有新意的事。全书基本上是正统的地层学、岩石学和定量岩相古地理学研究。关于油气勘探,原来写了不少,但在本书的定稿过程中,删得只剩下不到两页了。此愈深入细致地研究愈不敢多说话了。在本书最后一章不到两页的“从岩相古地理谈油气勘探”中,其实只说了三句话,即:第一,重视两个生油气古地理环境即塔东盆地和柯坪盆地的生油气条件;第二,重视斜坡带、白云岩及白云化石灰岩、滩相、不整合面下风化壳的储集条件;第三,不要过分相信礁的油气潜景。

现谨以此书和此三句话敬献给塔里木油田,敬献给我的邀请者孙龙德、田军和王招明同志,敬献给所有支持过这一研究工作的同志们。

由于种种原因,本书的出版时间晚了1~2年,晚于《中国寒武纪和奥陶纪岩相古地理》一书的出版时间,但《中国寒武纪和奥陶纪岩相古地理》^[6]已采用了本书中的有关资料 and 观点。因此本书仍然是《中国寒武纪和奥陶纪岩相古地理》的基础之一。

现在看来,单把寒武纪和奥陶纪的定量的单因素图和岩相古地理图编出来似乎少了些,要是把整个古生代的甚至所有地质时代的定量的单因素图和岩相古地理图都编出来,那会更好,那就可以为塔里木地区的油气勘探提供更多的科学依据。但这对我来说可能有点晚了,我年将8旬,已力不从心,已不敢

再向塔里木油田的领导甚至中国石油天然气集团公司的领导请战了。但我相信，这一基础地质工作一定会有人去做，而且一定会比我做得更好。

祝塔里木地区的油气勘探事业日益兴旺发达！

祝全国的油气勘探事业日益兴旺发达！

冯增昭

2005 年 6 月

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Preface

I have been engaged in the study on petrology and lithofacies paleogeography of Paleozoic marine carbonate rocks in North China and South China for a long time. I looked forward to going to Tarim long before, doing some studies on petrology and lithofacies paleogeography of Paleozoic, especially on the marine carbonate rocks of Cambrian and Ordovician there and providing some fundamental scientific evidence for exploration of oil and gas there. However, I had not had the opportunity before 2001.

In 2001, Vice General Manager Sun Longde of Tarim Oilfield, Manager Tian Jun of Oilfield Exploration Department, and President Wang Zhaoming of Exploration and Development Institute of Tarim Oilfield invited me to Tarim to make geological investigation and give lectures. At that time I knew the opportunity for me to do something for the Tarim Oilfield came.

Led by Senior Engineer Huang Zhibin and Engineer Yang Fan, Professor Bao Zhidong and I visited the Cambrian and Ordovician outcrop in Keping, visited the Mesozoic outcrop in South Tianshan Mountains, visited the rock-mineral laboratory, and visited the Tarim River and desert highway. They showed the previous research achievements and some rocks slides and photos to me. My sight was greatly widened. With such perceptual knowledge, taking the research achievements of petrology (especially dolostone petrology) and quantitative lithofacies paleogeography of Cambrian and Ordovician marine carbonate rocks in the Ordos of North China and in South China^[1-4] as examples, compared them with the research achievements of petrology, lithofacies paleogeography and exploration of oil and gas in the Tarim area^[5], I pointed out that the study on petrology and lithofacies paleogeography of the Cambrian and Ordovician, even the whole Paleozoic in the Tarim area was far from enough. Thus the exploration of oil and gas lacks the most fundamental geological groundwork, and it is inevitable that some optimistic opinions lacking scientific foundations, such as the over-estimation of petroleum potential of reefs in the Ordovician. Optimism, lacking scientific foundation, means uncertainty about the exact oil and gas exploration targets or direction. This is the key of the problem.

They were very interested in my academic report, and accepted my suggestion soon. Then a research subject "Study and Mapping of Lithofacies Paleogeography of the Cambrian and Ordovician of Tarim Area" was established. They require us to start the work as soon as possible. Originally, I suggested to do the study and to map the quantitative lithofacies paleogeography of the whole Paleozoic in the Tarim area, but they decided to start from the Cambrian and Ordovician first. The study of other geological ages may be discussed after that. I understand their prudent attitudes.

After accepting the research task, Professor Bao Zhidong and I began to make the research plan and organize manpower immediately. The study work formally started in November 2001.

Through more than two years' effort, the research subject was finished and the research achievements passed the appraisal in 2003.

In the course of the study, Professor Bao Zhidong presided over most work of guidance and organization, Professor Jin Zhenkui and postdoctor Wu Maobing also took part in the work of guidance and organization. Postdoctor Wu Maobing mainly undertook the daily research work. Masters such as Shi Xiaozhang, Li Wei, Yang Chunyu and doctor Zhang Dongling also took part in the study. The research group also received a lot of assistance from all of the persons, such as Sun Longde, Vice General Manager of Tarim Oilfield Corporation, Tian Jun, Manager of Oilfield Exploration Operation Department, President Wang Zhaoming, Vice President Wang Qinghua, Vice President Yang Wenjing, Senior Engineer Huang Zhibin, Zhao Zhixin, Gu Qiaoyuan, Sun Yushan, Zhang Shibei, and Engineer Yang Fan, all from the Exploration and Development Institute of Tarim Oilfield. Here I give sincere thanks to them all.

On the basis of the ultimate research achievements, and through more than ten times revision, the book, *Lithofacies Paleogeography of the Cambrian and Ordovician of Tarim Area*, was finalized. Miss Wang Yongping contributed a lot to typewriting and figure revision. Here I give sincere thanks to her.

The "Single Factor Analysis and Multifactor Comprehensive Mapping Method"^[1-6] initiated by me was adopted in the research and in this book. On the basis of quantitative petrological study of outcrop profiles and well profiles, quantitative study of lithofacies paleogeography and mapping of the Cambrian and Ordovician in the Tarim area were made, with the Lower Cambrian, Middle Cambrian, Upper Cambrian, Lower Ordovician Lianghekou Stage and Honghuayuan Stage, Middle Ordovician Dawan Stage and Guniutan Stage, Upper Ordovician Miaopo Stage, Upper Ordovician Baota Stage, and Upper Ordovician Linxiang Stage and Wufeng Stage as the mapping units. In total, 47 single factor maps and 8 lithofacies paleogeography maps were compiled. On this basis, corresponding character exposition were written, and the book was finished.

Originally, the ultimate research achievements also included the research achievements of two subject dolostones and karsting. But as the research achievements of these two subjects need further polished, they were deleted. It can only wait for future amendment.

It is a new thing to the Tarim area to compile quantitative single factor maps and quantitative lithofacies paleogeography maps of the Cambrian and Ordovician with the "Single Factor Analysis and Multifactors Comprehensive Mapping Method"^[1-6] and write the corresponding character exposition, because the quantitative study and mapping of lithofacies paleogeography is the first time in Tarim. The whole book is basically traditional study on stratigraphy, petrology and quantitative lithofacies paleogeography. About exploration of oil and gas, a lot was written originally. But during finalizing of this book, it was deleted to less than two pages. The deeper and more detailed the study was, the less we dared to say. In the "Discussion on oil and gas exploration from lithofacies paleogeography" of the final chapter of this book, only three points in fact were written, *i. e.* "Attention should be paid to oil-generating conditions of two

oil-and-gas-generating lithofacies paleogeographic environments *i. e.* the East Tarim Basin and Keping Basin; Attention should be paid to the reservoir conditions of the slope, dolostones, dolomitized limestones, bank facies and weathering crust under unconformity; Do not over trust in the petroleum potential of reefs. ”

Here I present these three suggestions and this book to the Tarim Oilfield, to my inviters Sun Longde, Tian Jun and Wang Zhaoming, and to all comrades who supported this research.

For some reasons, the publication of this book is later than that of *Lithofacies Paleogeography of the Cambrian and Ordovician in China*, but a great deal of single factor data and some viewpoints of this book were adopted by *Lithofacies Paleogeography of the Cambrian and Ordovician in China*. So, this book is one of the foundation of *Lithofacies Paleogeography of the Cambrian and Ordovician in China*.

In view of the present situation, it seems to be not enough to only compile the quantitative single factor maps and quantitative lithofacies paleogeography maps of the Cambrian and Ordovician. It should be more perfect if we can compile the quantitative single factor maps and quantitative lithofacies paleogeography maps of the whole Paleozoic or all geological ages. This will provide more scientific evidence for oil and gas exploration of the Tarim Oilfield. But to me, it may be too late. Now I am nearly 80 years old and my energy is not as good as before, so I don't dare to request task from the leaders of the Tarim Oilfield or CNPC. But I believe that someone else will do this basic geological work and they will do it better than me.

Wishes oil and gas exploration of the Tarim area more prosperous!

Wishes oil and gas exploration of our country more prosperous!

Feng Zengzhao

June 2005

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