石油英语系列教材

石油地质实用英语

解曙巍 主编

下册

PRACTICAL ENGLISH OF PETROLEUM GEOLOGY

石油大学出版社

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内容提要

该书是一套石油地质专业方面的实用英语教材。全书分上、下两册。上册课文内容以油气生成、运移、聚集、圈闭等石油地质学的基本概念及基础理论为主；下册课文内容则侧重于石油地质学的实际应用及与其密切相关的油气勘探与开发。全书共30课，每册15课。除篇幅适当的课文外，每课还包括详尽的生词和专业词组注解、习语和短语注解、课文注释和不同类型的练习题及与课文内容相配套的阅读材料等。此外，每册均附有“课文参考译文”、“练习题答案”、“词汇总表”、“习语和短语总表”，以充分利于教学与自学。

该书题材广泛、内容丰富、重点突出、结构紧凑，具有系统性、可读性和实用性，既可作为石油地质专业人员的英语培训教材或英语学习用书，亦可作为高等院校相关专业的英语教学参考书。

编著者说明

步入新世纪、加入WTO后，中国面临新的机遇与挑战。为适应我国石油领域对外交流与合作的迫切需要，提高石油科技工作者和有关涉外人员的专业英语水平与实用能力，胜利油田组织编著了石油英语系列教材。该系列教材包括石油地质、地球物理勘探、钻井、测井、采油、安全环保等专业。各专业英语教材的编著自成体系，独立成书。《石油地质实用英语》(*PRACTICAL ENGLISH OF PETROLEUM GEOLOGY*)是该英语系列教材之一。

《石油地质实用英语》分上、下两册，按石油地质专业知识结构并兼顾英文难易程度进行编排。上册课文内容以油气生成、运移、聚集、圈闭等石油地质学的基本概念及基础理论为主；下册课文内容则侧重于石油地质学的实际应用及与其密切相关的油气勘探与开发。参考、引用文献主要源自正式出版的英美原著，经精心编著，力求使课文既内容完整，又层次清晰、重点突出，并使全书从总体上体现连续性、系统性、可读性和实用性。

上、下两册共30课，每册15课。每课包括：课文(TEXT)、生词和专业词组(NEW WORDS AND SPECIALIZED PHRASES)、习语和短语(IDIOMS AND EXPRESSIONS)、课文注释(NOTES TO THE TEXT)、练习题(EXERCISES)及阅读材料(READING MATERIAL)等。全书课文、阅读材料各选编30篇，生词和专业词组注解3 170多条，习语和短语注解390多条。为充分利于教学与自学，每册均附有“课文参考译文”、“练习题答案”、“词汇总表”、“习语和短语总表”。

此外，为方便读者，上册附有英汉对照的“地质年代与地层时序表”、“地质时代符号表”、“API重度与相对密度对照表”；下册附有英汉对照的“地质图常用符号表”、“常用单位换算表”、“石油地质及相关专业常用英文期刊一览表”。

在中国石化胜利石油管理局教育培训处部署下，在中国石化胜利油田地质科学研究院组织下，全书由胜利油田地质科学研究院与石油大学外国语学院合作编著。解曙巍任主编，张桂萍、王宏、王青、张建国任副主编。参加编著工作的还有赵剑敏、王宏宇。在编著过程中承蒙有关专家及同仁的热诚协助，张宏逵参与了上册“课文参考译文”部分的核校工作，胡济世参与了上、下册“课文参考译文”部分的核校工作，吴锦莲参与了上册课文部分词汇的初步筛选与注解工作，在此一并表示诚挚的谢意。

编著这样一套系统而正规的石油地质类英语教材，是一件很有意义的事情，但也是一项颇为复杂的工程。为此，我们付出了辛勤的努力，但由于我们水平有限，书中难免存有差错或不当之处，敬请读者批评指正。

编著者

2003年5月

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LESSON ONE

TEXT

GEOLOGICAL AND PHYSICAL BASES OF HYDROCARBONS DETECTION

The technique of direct detection of hydrocarbons by geophysical methods has been developed in the Soviet Union since the 1950s when exploration seismologists I. I. Ballah, I. G. Medovskii and K. A. Mustafayev first proved the possibility of detecting in a seismic wave field, the effects of hydrocarbon accumulations: appearance of reflections from fluid contacts and decrease in coherence of reflections from interfaces below the accumulation.

Systemic development of theoretical and practical principles of direct geophysical detection of hydrocarbons started in the 1960s when theoretical, laboratory, borehole and field studies were carried out which laid down the geological/physical foundations of predicting hydrocarbon accumulations. The main diagnostic characteristics of geophysical anomalies related to hydrocarbons were established.

The geological/physical basis of direct detection of hydrocarbons is the change in a number of physical properties of oil-saturated portions of an oil reservoir in comparison with water-saturated parts: decrease in P-wave velocity and increase in absorption, changes in acoustic impedance and reflection coefficients at the reservoir boundaries in the vicinity of the accumulation and at gas-oil-water contacts, decrease in rock density, changes in electric characteristics, etc. ①

In addition to this it was ascertained that penetration of hydrocarbons into the host rocks causes epigenetic variation in the physical properties of the rock both in the vicinity of the accumulation, especially at water/gas interfaces and in the region of the trace of diffusion flow known as a halo effect. ② The halo effect is observed in many oil fields. It is associated with non-productive gas accumulations and can affect rocks a few hundred metres thick above the deposit and then die away.

Thus a hydrocarbon accumulation produces complex geological/physical inhomogeneity which, as parametric measurements show, can create anomalies in various wave and potential fields. Parametric measurements conducted in tens of known fields show that under favourable conditions these anomalies can be registered by modern geophysical instruments on the earth's surface. Taking into consideration different dependence of the parameters in different geophysical fields upon rock properties (porosity, fluid-saturation, permeability etc.), we may presume that there are at least necessary conditions for combining of geophysical methods for the purpose of solution of the direct detection problem.③ However, a scientifically-grounded and proved approach to the optimum combination of geophysical methods for direct detection of hydrocarbons has not been developed yet. It can be explained by the fact that representative, quantitative estimates (differentiated by the types of geological provinces and fields) of possible accuracy of predicting accumulations by individual methods, have not been found yet.

Accumulation prediction is sub-divided into a few stages: extracting useful signals from the data observed; measuring of anomalies, of their parameters, created by sub-surface inhomogeneities; identification of the nature of the detected anomalies and quantitative interpretation of useful anomalies. All this still remains a challenge. Since observed anomalies are related to a great number of side factors and geological bodies even the extraction of a weak effect of the accumulation from the aggregate anomaly is not always certain and reliable enough. The accuracy and reliability of prediction is not equal for different methods.

Recently some positive results have been obtained in application to the search of sub-surface geological/physical inhomogeneities of such methods as high-precision gravity survey, aeromagnetic survey, telluric sounding and transient measurements in a near zone.④ However, these methods allow only qualitative interpretation of anomalies and at best determination of possible outline of the accumulation in plan.

For detailed study, i.e. for defining pool limits in 3-D space, its geometrical configuration and physical parameters there is only one method of geophysical prospecting for the present. This method is reflection seismic. That is why below we concentrate on seismic detection of hydrocarbons.

The results of studies carried out over the last few years show that the following diagnostic characteristics (indicators) can be used for detecting seismic anomalies associated with a hydrocarbon accumulation: (1) Decrease in average and effective velocities of reflections underlying the accumulation; (2) Decrease in interval velocities within the accumulation; (3) Increase in interval times within the accumulation; (4) Increase in attenuation of waves passing through the accumulation; (5) Changes in the frequency content of waves passing through the accumulation; (6) Reduction in coherence of waves passing through the accumulation; (7) Increase in the amplitude of waves reflected from gas-oil-saturated layers; (8) Appearance of reflections from the bottom of the accumulation and contacts; (9) Changes in the shape and phase of the wave reflected from the top of the reservoir accompanied sometimes by diffraction on the flanks of the accumulation.

The above indicators can be subdivided into three groups: (1)~(3), (4)~(6), (7)~(9).

The first group of indicators (1)~(3) reflects the effect of the accumulation on seismic velocities and requires high-accuracy techniques of velocity determination.

The established technique of velocity determination suggests the following sequence of procedures: continuous velocity (v_{NMO}) analysis; v_{NMO} editing and elimination of velocity values distorted by lengthy inhomogeneities in the near-surface; v_{NMO} averaging along the line and over the area; conversion to interval and average velocities; generation of velocity maps. Iso-velocity sections of effective and average velocities are also plotted.

The indicators (4)~(6) characterize the aggregate effect of the accumulation and its halo on the wave field: equal change in wavelet characteristics of primary reflections in the entire broad time interval below the accumulation. One can expect that relative weight of these indicators will be greater for accumulations with strong halo and/or large total thickness of productive section. This is corroborated by the results of field data processing.

The above mentioned character of display of these indicators in the wave field makes it possible for their evaluation to use techniques (based on calculation of integral averaged in large time intervals) estimates of wave parameters.⑤ These techniques have less depth resolution but are more noise-resistant and relatively less expensive.

The indicators (7)~(9) characterize the hydrocarbon effects observed in the narrow, local (in space and time) domain of the wave field. This domain corresponds to the accumulation itself and its immediate proximity. Among local effects variation of interface reflective power, producing within the accumulation anomalous amplitude of the reflection from the reservoir top, has the most exploration significance, especially in the search for gas. The less difference in acoustic impedance between the water-saturated reservoir and overlying rocks, larger thickness of the accumulation and higher content of free and dissolved gas is, the larger are amplitude variations.⑥

Thus when indicators (1)~(3), which are interdependent and reflect variations in lithology, are used alone they cannot serve as sufficiently reliable indications of hydrocarbons. It is necessary to combine them with indicators (4)~(9) which mainly characterize the effect of hydrocarbons on amplitude, frequency content, coherence and waveshape of reflections.

This remains to be studied by evaluation of gathered and new experimental data and presents a hard problem. Moreover, even theoretical estimates of expected effect of the accumulation on the wave field have been so far obtained only for a limited class of models. Much work should be done to study real media and create their models, develop techniques of their study using mathematical and physical modelling, investigate relationships between physical rock properties and seismic wave characteristics, improve techniques and interpretation of measurements. Use of the theory of pattern recognition for integrated interpretation of seismic anomalies seems potential.

Thus, the direct detection method by geophysical means is far from completion. It involves a number of difficult and unsettled problems. Nevertheless, the practical results obtained allow us to look ahead with optimism.

NEW WORDS AND SPECIALIZED PHRASES

geological [dʒiə'lɔdʒikəl] *a*. 地质的，地质学的

detection [di'tekʃən] *n*. 检测，探测；发现，检波

the Soviet Union 苏联

detect [di'tekt] *vt*. 检测，探测；发现

seismologist [saiz'mɔlədʒist] *n*. 地震学家，地震工作者
seismic wave 地震波
decrease [di:'kri:s] *v*. 降低，减小，减少 *n*. 减小，减少
coherence [kəu'hiərəns] *n*. 相干性，相关性
systemic [sis'temik] *a*. 系统的
theoretical [θiə'retikəl] *a*. 理论的，理论上的，推理的
principle ['prinsəpl] *n*. 原理，原则
bore [bɔ:] *n*. 眼，炮眼，孔 *v*. 打眼
  bore hole 井眼，炮眼
field [fi:ld] *n*. 油田；场；野外 *a*. 野外的，现场的
foundation [faun'deiʃən] *n*. 基础，底；建立
diagnostic [ˌdaiəg'nɔstik] *a*. 诊断的，特征的，有特征的 *n*. 诊断，特征
characteristic [ˌkæriktə'ristik] *n*. 特性，特征；特性曲线 *a*. 特有的
anomaly [ə'nɔməli] *n*. 异常，反常
saturated ['sætʃəreitid] *a*. 饱和的，浸透的
portion ['pɔ:ʃən] *n*. 部分，区划，区段
oil reservoir 油层，油储，储油层
P-wave *n*. P 波，压缩波，纵波
absorption [əb'sɔ:pʃən] *n*. 吸收
acoustic [ə'ku:stik] *a*. 声的，声学的，有声的，听觉的
  acoustic impedance 声阻抗
reflection coefficient 反射系数，反射率
vicinity [vi'siniti] *n*. 附近，邻近
gas-oil-water contact 油气水界面，气-油-水接触面
ascertain [ˌæsə'tein] *vt*. 确定，定出，查明
penetration [peni'treiʃən] *n*. 穿透；穿透深度；穿透力
host [həust] *n*. 基质，晶核
  host rock 围岩，主岩
epigenetic [ˌepidʒi'netik] *a*. 后成的，后生的，外生的，表生的
  epigenetic variation 后成变化
water/gas interface 气水界面
halo ['heiləu] *n*. 晕，晕圈；环带
  halo effect 环晕效应；环状异常
non-productive ['nɔnprə'dʌktiv] *a*. 非生产性的，无生产能力的
inhomogeneity ['inˌhɔməudʒe'ni:iti] *n*. 不均匀性，非均质性；不同质，不同类
parametric [ˌpærə'metrik] *a*. 参数的，参量的
measurement ['meʒəmənt] *n*. 测量；测量法
potential field 势场，位场
register ['redʒistə] *v*. 记录
consideration [kənˌsidə'reiʃən] *n*. 考虑；讨论；关心
parameter [pə'ræmitə] *n*. 参数，参量
saturation [ˌsætʃə'reiʃən] *n*. 饱和，饱和状态，饱和度
presume [pri'zju:m] *v*. 假定，假设，设想，认为
optimum ['ɔptiməm] *a*. 最佳的，最宜的
representative [ˌrepri'zentətiv] *a*. 可作…的典型的，代表的，有代表性的
differentiate [ˌdifə'renʃieit] *v*. 区别，分别；(求)微分
geological province 地质区域
subdivide ['sʌbdi'vaid] *v*. 细分，再分
stage [steidʒ] *n*. 步骤；阶段；期
sub-surface (= subsurface) ['sʌb'sə:fis] *a*. 地下的；地面下的；水面下的 *n*. 地下；地表下岩石
identification [aiˌdentifi'keiʃən] *n*. 识别，鉴别，鉴定，查明
challenge ['tʃælindʒ] *n*. 挑战，复杂问题 *vt*. 向…挑战，要求 *vi*. 提出挑战，反对
side [said] *a*. 次要的，附带的
geological body 地质体
aggregate ['ægrigit] *a*. 总的，共同的；['ægrigeit] *vt*. (使)聚集，合计
positive ['pɔzətiv] *a*. 实际的，积极的，肯定的
precision [pri'siʒən] *n*. 精确，精确性；精密，

精密度

gravity ['græviti] *n*. 重力,地心引力

survey [sə(:)'vei] *vt*. 勘查,观测,测量;['sə:vei] *n*. 勘查,观测,测量

gravity survey 重力测量

aeromagnetic [ˌɛərəmæg'netik] *a*. 航空磁测的,航磁的

aeromagnetic survey 航空磁测

telluric [te'ljuərik] *a*. 大地的;地球的

sounding ['saundiŋ] *n*. 测深,水深测量

transient ['trænziənt] *a*. 瞬变的,瞬时的 *n*. 瞬态,瞬变状态

qualitative ['kwɔlitətiv] *a*. 定性的,性质上的

interpretation [inˌtə:pri'teiʃən] *n*. 解释

qualitative interpretation 定性解释

outline ['autlain] *n*. 轮廓,外形;探边

geometrical [dʒiə'metrikəl] *a*. 几何的,几何学的,几何图形的

geometrical configuration (= geometric configuration) 几何形状

indicator ['indikeitə] *n*. 标识,标记,迹象;指示器

effective [i'fektiv] *a*. 有效的

velocity [vi'lɔsiti] *n*. 速度

effective velocity 有效速度

underlying [ˌʌndə'laiiŋ] *a*. 在下面的,下伏的,底层的;基本的

interval ['intəvəl] *n*. 间隔,层段,井身两点间距离;区间

interval velocity 层速度

increase [in'kri:s] *v*. 增加,提高;['inkri:s] *n*. 增加,提高

interval time 间隔时间

attenuation [əˌtenju'eiʃən] *n*. 衰减

content [kən'tent] *n*. 容量,含量;[*pl*.] 内容

frequency content 频率组成

reduction [ri'dʌkʃən] *n*. 降低,减小;还原

accompany [ə'kʌmpəni] *vt*. 伴随,伴生,与…同时发生,与…同时进行

diffraction [di'frækʃən] *n*. 绕射,衍射

flank [flæŋk] *n*. 翼,侧面

seismic velocity 地震速度

determination [diˌtə:mi'neiʃən] *n*. 测定,确定

procedure [prə'si:dʒə] *n*. 程序,步骤;方法;过程

elimination [iˌlimi'neiʃən] *n*. 消去,清除,消元法

distort [dis'tɔ:t] *v*. (使)变形,扭曲,畸变

near-surface *n*. 近地表 *a*. 近地表的

conversion [kən'və:ʃən] *n*. 变换,换算,反演

iso-velocity (= isovelocity) [ˌaisəuvi'lɔsiti] *n*. 等速,等速线

plot [plɔt] (plotted ['plɔtid]; plotting ['plɔtiŋ]) *vt*. 标绘;绘制…的图 *n*. 曲线,曲线图

characterize ['kæriktəraiz] *vt*. 叙述[描写]…的特性;鉴定;表示…的特性;以…为特性

wave field 波场

wavelet ['weivlit] *n*. 子波

primary ['praiməri] *a*. 一次的;原始的

primary reflection 一次反射,原始反射

time interval 时间间隔,时段

productive section 生产层段,生产剖面

corroborate [kə'rɔbəreit] *vt*. 确证,证实

field data 野外数据,现场数据

character ['kæriktə] *n*. 性质,特性,特征

depth resolution 深度分辨率

resistant [ri'zistənt] *a*. 抵抗的,抵抗力的,有抵抗力的

domain [dəu'mein] *n*. 区域,范围

immediate [i'mi:djət] *a*. 最接近的,即刻的

proximity [prɔk'simiti] *n*. 邻近,附近

reflective [ri'flektiv] *a*. 反射的

reflective power 反射能力,反射率

anomalous amplitude 异常振幅

overlying [ˌəuvə'laiiŋ] *a*. 上覆的

overlying rock 盖层,上覆岩层

inter-dependent [ˌintə(:)di'pendənt] *a*. 相互依赖的,相互关联的,相互影响的

sufficiently [sə'fiʃəntli] *ad*. 十分地,充分地,充足地

shape [ʃeip] *n*. 形状,形态

wave shape 波形

gather ['gæðə] *v*. 收集,采集

experimental data 实验数据

media ['mi:djə] *n*. 介质,媒质;方法,手段(*sing*. medium ['mi:djəm])

real media 实际介质

create [kri(:)'eit] *vt*. 建立,产生,造成

model ['mɔdl] *n*. 模型,样品,模式

mathematical (= mathematic) [ˌmæθi'mætikəl] *a*. 数学的,数学上的,数理的

model(l)ing ['mɔdliŋ] *n*. 模拟,模型制造

physical modelling 物理模拟

investigate [in'vestigeit] *v*. 调查,探查

pattern ['pætən] *n*. 型,模型;组合;图形;井网,布井系统

integrate ['intigreit] *v*. 使完整,使一体化,集成,合成

direct detection 直接检测

means [mi:nz] *n*. [单复数同]手段,方法

completion [kəm'pli:ʃən] *n*. [油井]完成,完井;结束,满期

unsettled ['ʌn'setld] *a*. 不定的,未解决的

optimism ['ɔptimizəm] *n*. 乐观,乐观主义,信心

LESSON ONE

IDIOMS AND EXPRESSIONS

decrease in... …(的)减少

increase in... …(方面)增;…的增加

to start in 开始,动手

to carry out 实现,完成,求得

to lay down 放下,设计,制定,主张

related to 与…有关,与…有关系

a number of 一些,许多,若干

in comparison with... 与…相比,同…比较起来

in the vicinity of... 在…的附近,靠近…

known as 称为,被认为是,叫做

to die away 消逝,消失,衰减,熄灭

dependence of *A* on *B* A对B的依赖关系,A对B的关系曲线

at least 至少,最低程度,无论如何

to be used for 用来作,用于

based on 以…为基础,基于,根据

to be necessary to …是…所必要(的),…是…所必需(的)

far from 远离,完全不,远远不

NOTES TO THE TEXT

1. The geological/physical basis of direct detection of hydrocarbons is the change in a number of physical properties of oil-saturated portions of an oil reservoir in comparison with water-saturated parts: decrease in P-wave velocity and increase in absorption, changes in acoustic impedance and reflection coefficients at the reservoir boundaries in the vicinity of the accumulation and at gas-oil-water contacts, decrease in rock density, changes in electric characteristics, etc.

   本句主干结构为:the...basis...is the change....。冒号后面有四个并列成分,即"decrease..., changes..., decrease..., changes...",作主干结构中the change的同位语,起补充说明的作用。