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新疆准噶尔盆地东缘五彩湾地区煤田钻孔数据集

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摘要：新疆准噶尔盆地是中国油气、煤炭等能源矿产的重要储集场所。本次研究对搜集到的准噶尔盆地东缘五彩湾地区 20 个煤田钻孔资料进行二次开发利用，通过提取钻孔坐标、高程、地层分层厚度、颜色、测井曲线解译数据等重要信息，重新建立了钻孔数据集。数据集共包含 20 个钻孔资料的 Excel 数据库型数据，每个 Excel 数据库由“钻孔基本信息”、“测井解释岩性分层”、“地质编录柱状分层”、“综合柱状信息”、“钻孔岩性分层”、“地层名称及代号表”、“地层颜色”、“测井曲线配置”、“测井曲线数据”、“数据字典”等 10 个工作表组成。利用石文软件可读取数据集信息，绘制地层沉积三维立体图，该成果能够对准噶尔盆地东缘五彩湾地区砂体的空间展布、三维地质结构等提供更加直观的认识，对研究准噶尔盆地东缘五彩湾地区的沉积环境具有重要意义。

关键词：准噶尔盆地；五彩湾；煤田钻孔；沉积地层；数据集

数据服务系统网址：http://dcc.cgs.gov.cn

1　引言

通过对中国鄂尔多斯、松辽、二连等北方重要能源盆地的钻孔资料进行二次开发建立钻孔数据库，对认识区域沉积地层展布和三维地质结构有着重要意义，同时对于勘查区域能源矿产具有重要的指导价值（张天福等，2016，2018，2019；冯晓曦等，2019；汤超等；2018；魏佳林等，2018）。准噶尔盆地位于新疆北部，东西为准噶尔界，南北夹持于天山与阿尔泰山之间，形态大致呈三角形，面积约为 1.3×10^5 km^2，是在准噶尔地块上发展起来的晚石炭世—第四纪沉积盆地，是中国西北地区重要的油气和煤炭资源盆地（Wang T et al., 2012；陈发景等，2005；杨有星等，2010）。准噶尔盆地东缘侏罗纪沉积地层是油气、煤炭等资源的重要储集层（Li M et al., 2014；鲍志东等，2011；韩守华等，2012），建立钻孔数据库对认识准噶尔盆地的三维地质结构和沉积环境以及更深层次地勘查区域能源矿产具有指示意义。多年来，为勘探准噶尔盆地油气和煤炭等资源，前人布设了大量钻孔，累积了海量的钻孔数据。本文工作通过建立准噶尔盆地东缘

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五彩湾地区煤田钻孔数据集，对认识该区地层砂体的空间展布、三维地质结构和古沉积环境具有重要意义（图 1）。

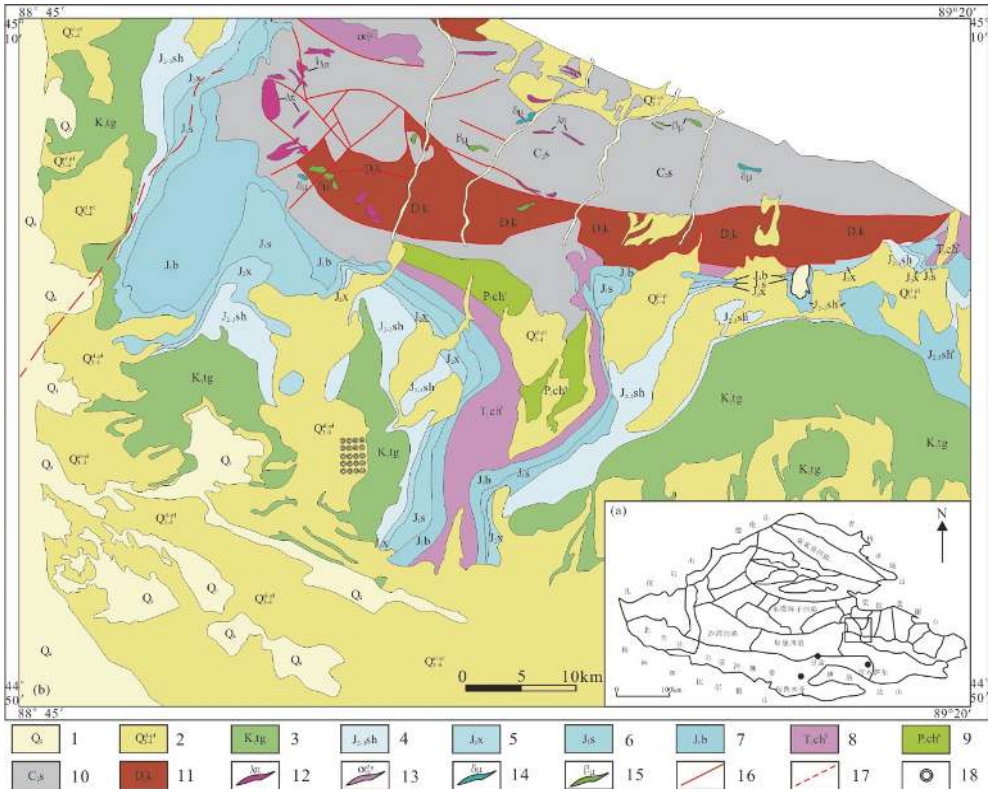

图 1　准噶尔盆地东缘五彩湾地区地质图及钻孔位置

1—第四系风成积砂；2—第四系冲洪积物；3—早白垩世吐谷鲁群；4—中-晚侏罗世石树沟群；5—中侏罗世西山窑组；6—早侏罗世三工河组；7—早侏罗世八道湾组；8—早三叠世上仓房沟群；9—晚二叠世下仓房沟群；10—中石炭世石钱滩群；11—中泥盆世克拉美丽组；12—细粒闪长岩；13—石英霞石岩；14—闪长斑岩；15—辉绿岩；16—断层；17—推测断层；18—钻孔

建立准噶尔盆地东缘五彩湾地区煤田钻孔数据集以前人获得的钻探数据为基础，是对煤田钻孔资料进行的“二次开发”。为充分发挥地质钻孔资料的作用，本次工作大规模地收集了前人的钻孔资料（阮传明等，2008），按照统一的标准和要求（周小希等，2016），将煤田、石油等类型的重要钻孔资料通过整理、扫描、数据类型转换、录入和集成，建成钻孔数据库。

准噶尔盆地东缘五彩湾地区煤田钻孔数据集（程先钰等, 2020）由 20 个 Excel 数据库型数据组成。每个 Excel 数据库内部包含“钻孔基本信息”、“测井解释岩性分层”、“地质编录柱状分层”、“综合柱状信息”、“钻孔岩性分层”、“地层名称及代号表”、“地层颜色”、“测井曲线配置”、“测井曲线数据”、“数据字典”等 10 个工作表。

准噶尔盆地东缘五彩湾地区煤田钻孔数据集元数据简表如 (表 1) 所示。

2　数据采集和处理方法

2.1　数据基础

准噶尔盆地东缘五彩湾地区煤田钻孔资料从新疆维吾尔自治区地质资料馆搜集而

表 1　数据库（集）元数据简介

条目	描述
数据库（集）名称	新疆准噶尔盆地东缘五彩湾地区煤田钻孔数据集
数据库（集）作者	程先钰，中国地质调查局天津地质调查中心 张天福，中国地质调查局天津地质调查中心
数据时间范围	2019年
地理区域	新疆维吾尔自治区昌吉回族自治州吉木萨尔县五彩湾
数据格式	.xls
数据量	8.94 MB
数据服务系统网址	http://dcc.cgs.gov.cn
基金项目	天山—华北陆块铀钍等矿产资源调查项目（项目编号：DD20190813）
语种	中文
数据库（集）组成	本数据集共包含ZK001、ZK002、ZK003、ZK0101、ZK0107、ZK0108、ZK0109、ZK0201、ZK0202、ZK0203、ZK0204、ZK0205、ZK0206、ZK0207、ZK0208、ZK0209、ZK0210、ZK0301、ZK0306、ZK0307等20个钻孔资料的Excel数据库型数据，每个Excel数据库内包含有10个工作表，分别为“钻孔基本信息”、“测井解释岩性分层”、“地质编录柱状分层”、“综合柱状信息”、“钻孔岩性分层”、“地层名称及代号表”、“地层颜色”、“测井曲线配置”、“测井曲线数据”、“数据字典”

来，主要选取神东天隆集团有限责任公司承担的新疆准噶尔盆地东缘煤田吉木萨尔县五彩湾 (天隆) 露天矿勘查项目中 ZK001、ZK002、ZK003、ZK0101、ZK0107、ZK0108、ZK0109、 ZK0201、 ZK0202、 ZK0203、 ZK0204、 ZK0205、 ZK0206、 ZK0207、ZK0208、ZK0209、ZK0210、ZK0301、ZK0306、ZK0307 等 20 个钻孔资料，提取钻孔坐标、地层砂体的厚度、顶底深度、颜色、砂体粒度等重要信息，从而形成 Excel 数据库型数据。

2.2　数据处理过程

2.2.1　数据准备

钻孔数据信息可以揭露区域地层层序及岩土体类型，进而为区域三维地质模型的建设提供地质数据信息（孙巧银等，2018，2019）。本次工作汇总了“钻孔柱状图”和“测井综合成果图”，以备数据提取，将勘查报告、区域地质图等文件另存为“其他”文件夹。

2.2.2　数据提取

通过对“钻孔柱状图”、“测井综合成果图”中有利信息的提取，以达到数据集建立的初始目的。

（1）在“钻孔柱状图”中主要提取钻孔坐标、比例尺、地层组段信息、地层岩性划分、顶底深度、砂体厚度、砂体颜色等信息。

（2）在“测井综合成果图”中主要提取自然伽马测井曲线的数据。由于测井曲线为.jpg 格式，所以需要通过石文 GraphToDigital 软件将曲线转化为数值。具体操作流程为：①打开软件，在文件菜单中打开测井综合成果图，限定待测曲线的上、下、左、右值，并读出数值完成填写；②选取追踪曲线颜色后，开始追踪，追踪后进行曲线微调，尽量与原曲线一致，最后导出数据，操作界面如图 2；③导出的数据类型为.txt 格式，最终转化为.xls 格式。

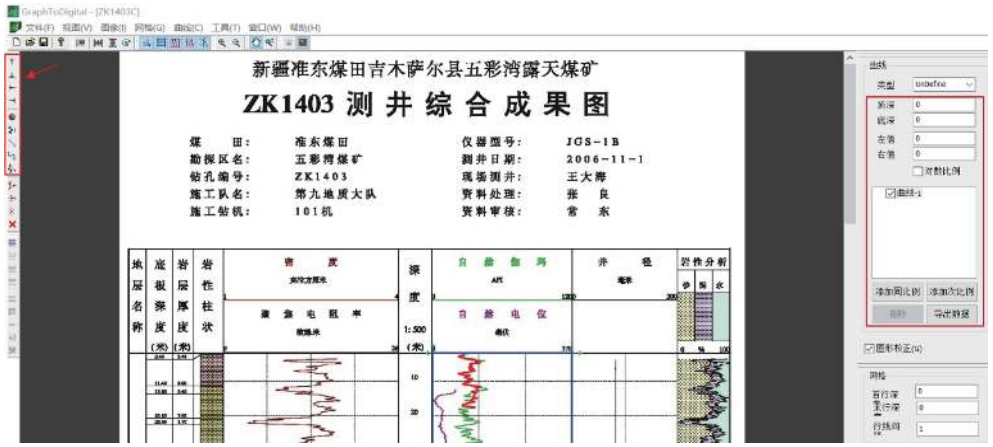

图 2　石文 GraphToDigital 软件操作界面

3　数据样本描述

每个 Excel 型数据库包含 10 个工作表，其中“钻孔基本信息”、“测井解释岩性分层”、“综合柱状分层”、“地层名称及代号”、“地层颜色”、“测井曲线配置”、“测井曲线数据”为必填的 7 个工作表，“地质编录柱状分层”、“钻孔岩性分层”、“数据字典”3 个表格为选填表。数据库的逻辑结构见图 3。由于每个工作表的项目较多，所以表 2–8 仅列举必填项（表 2-8 中所列样例数据来自数据集 DD20190813-3ZK001.xlsx）。建立的数据库需要严格按照模板进行填写，否则石文软件无法读取其中的数据信息。

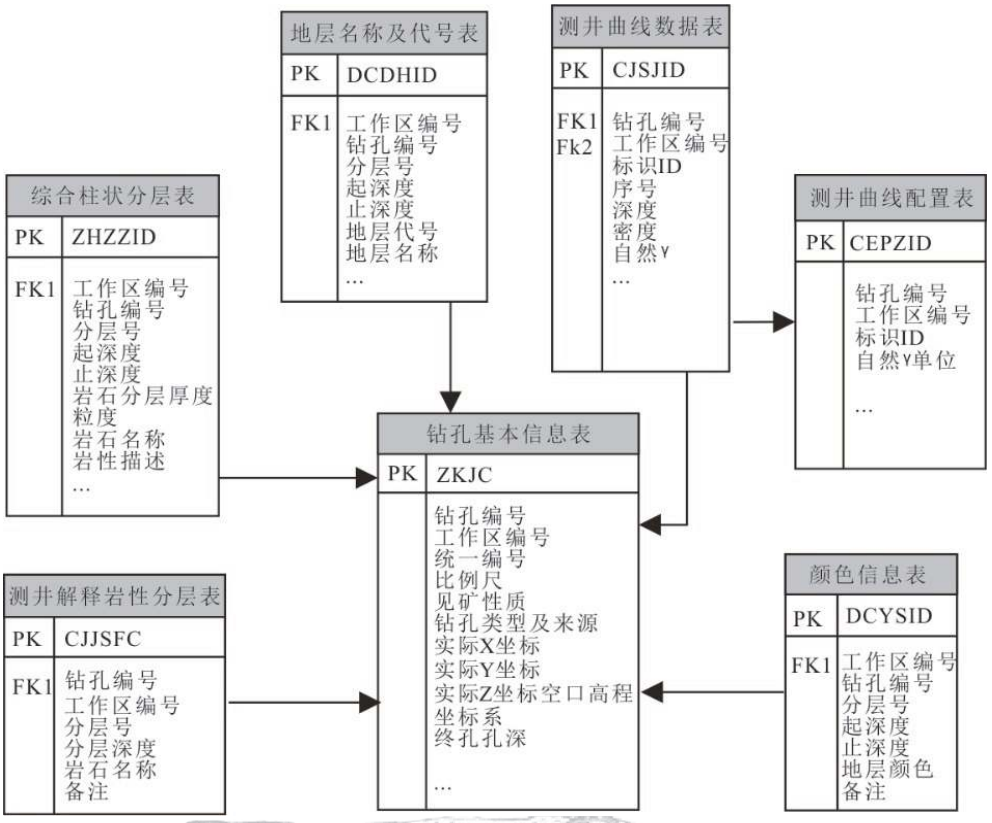

图 3　数据逻辑结构图

表 2　钻孔基本信息表（TABLE_ZKJC）

工作区编号 GQBH	钻孔编号 TKALA	统一编号 PKIAA	比例尺 BLC	见矿性质 JKXZ	钻孔类型及来源ZKLX	实际X坐标 TKCAF	实际Y坐标 TKCAG	实际Z坐标/孔口高程TKCAI	坐标系 ZBX	终孔孔深/m TKACCA
DD20190813-3	ZK001	DD20190813-3ZK001	1：500	2	1	4958552.446	30420439.933	484.755	西安1980	420.42

表 3　测井解释岩性分层表（TABLE_CJJSFC)

工作区编号 GQBH	钻孔编号 TKALA	分层号 GGON	分层深度/m MDBFND	岩石名称 YSEB
DD20190813-3	ZK001	1	37.16	砾岩
DD20190813-3	ZK001	2	52.64	泥岩
DD20190813-3	ZK001	3	184.05	粉砂岩
DD20190813-3	ZK001	4	232.21	细砂岩
DD20190813-3	ZK001	5	276.47	粉砂岩
DD20190813-3	ZK001	6	277.10	砾岩
DD20190813-3	ZK001	7	283.01	泥岩
DD20190813-3	ZK001	8	293.76	泥质粉砂岩
DD20190813-3	ZK001	9	298.05	中砂岩
DD20190813-3	ZK001	10	307.29	粉砂质泥岩

表 4　综合柱状分层表 (TABLE_ZHZZFC)

工作区编号 GQBH	钻孔编号 TKALA	分层号 GGON	起深度/m TKYXQ	止深度/m TKYXZ	岩石分层厚度/m YSFCHD	粒度 YXLD	岩石名称 YSEB	岩性描述 YXMS
DD20190813-3	ZK001	1	0.00	37.16	37.16	砾	砾岩	砾岩
DD20190813-3	ZK001	2	37.16	52.64	15.48	泥	泥岩	泥岩
DD20190813-3	ZK001	3	52.64	184.05	131.41	粉砂	粉砂岩	粉砂岩
DD20190813-3	ZK001	4	184.05	232.21	48.16	细砂	细砂岩	细砂岩
DD20190813-3	ZK001	5	232.21	276.47	44.26	粉砂	粉砂岩	粉砂岩
DD20190813-3	ZK001	6	276.47	277.10	0.63	砾	砾岩	砾岩
DD20190813-3	ZK001	7	277.10	283.01	5.91	泥	泥岩	泥岩
DD20190813-3	ZK001	8	283.01	293.76	10.75	粉砂	泥质粉砂岩	泥质粉砂岩
DD20190813-3	ZK001	9	293.76	298.05	4.29	中砂	中砂岩	中砂岩
DD20190813-3	ZK001	10	298.05	307.29	9.24	泥	粉砂质泥岩	粉砂质泥岩

表 5　地层名称及代号表 (TABLE_DCDH)

工作区编号 GQBH	钻孔编号 TKALA	分层号 GGON	起深度/m TKDCQ	止深度/m TKDCZ	地层代号 DCDHDSBF	岩石地层单位名称 DSBF
DD20190813-3	ZK001	1	0.00	37.16	Q	第四系
DD20190813-3	ZK001	2	37.16	52.64	N#-2#=d	独山子组
DD20190813-3	ZK001	3	52.64	277.10	K#-1#=tg	吐谷鲁群
DD20190813-3	ZK001	4	227.10	333.27	J#-2-3#=sh	石树沟群

4　数据质量控制和评估

准噶尔盆地东缘五彩湾地区煤田钻孔资料来自神东天隆集团有限责任公司 2008 年提交的新疆准噶尔盆地东缘煤田吉木萨尔县五彩湾 (天隆) 露天矿勘查报告。资料搜集于新疆地质资料馆，是前人按照国家相关的规范和规定汇交的成果资料。本次数据集的建

表 6　地层颜色表（TABLE_DCYS）

工作区编号 GQBH	钻孔编号 TKALA	分层号 GGON	起深度/m TKYSQ	止深度/m TKYSZ	地层颜色 YSHB
DD20190813-3	ZK001	1	0.00	37.16	灰黄
DD20190813-3	ZK001	2	37.16	52.64	砖红
DD20190813-3	ZK001	3	52.64	184.05	红褐
DD20190813-3	ZK001	4	184.05	232.21	灰绿
DD20190813-3	ZK001	5	232.21	276.47	红褐
DD20190813-3	ZK001	6	276.47	277.10	褐
DD20190813-3	ZK001	7	277.10	283.01	紫红
DD20190813-3	ZK001	8	283.01	293.76	紫红
DD20190813-3	ZK001	9	293.76	298.05	灰绿
DD20190813-3	ZK001	10	298.05	307.29	紫红

表 7　测井曲线配置表（TABLE_CJQXPZ）

工作区编号/GQBH	钻孔编号/TKALA	标示ID/PRECID	自然γ单位/ZRGMDW
DD20190813-3	ZK001	1	API

表 8　测井曲线数据表（TABLE_CJQXSJ）

工作区编号/GQBH	钻孔编号/TKALA	标示ID/PRECID	序号/GGON	深度/DMZKSD	自然γ/ZRGM
DD20190813-3	ZK001	1	1	0.3500	18.67
DD20190813-3	ZK001	1	2	0.4000	19.05
DD20190813-3	ZK001	1	3	0.4500	19.94
DD20190813-3	ZK001	1	4	0.5000	20.25
DD20190813-3	ZK001	1	5	0.5500	20.25
DD20190813-3	ZK001	1	6	0.6000	20.13
DD20190813-3	ZK001	1	7	0.6500	19.56
DD20190813-3	ZK001	1	8	0.7000	18.67
DD20190813-3	ZK001	1	9	0.7500	18.10
DD20190813-3	ZK001	1	10	0.8000	17.27

立，是对钻孔资料的二次开发。在信息提取过程，通过多次人工自检、互检，以达到质量检查要求，使石文软件可以正常读取数据。通过石文 Gxplorer 软件对数据集进行读取，绘制成准噶尔盆地东缘五彩湾地区的三维地质结构图（图 4），更加直观地反映了该地区的沉积特征与沉积结构。

5　数据价值

本次钻孔数据集的建立目的是为了编制工作区的三维地质结构图，以更加直观的方式显示工作区的沉积特征，同时通过数据集成挖掘出更多有意义的信息，解释区域上的关键地质问题。本次工作收集的钻孔位于五彩湾地区帐篷沟背斜西翼，由图 4a 可知，区域上地形呈西部坳陷、东部隆起的延伸趋势；图 4b、4c 显示地层延展性较好、未见组段缺失、砂体分布均匀，整体呈上薄下厚的沉积特征，表明该区曾处于稳定的沉积环境；图 4d 显示主体为黄色砂体，夹薄层状灰色砂层，底部为深灰色泥岩层。帐篷沟背

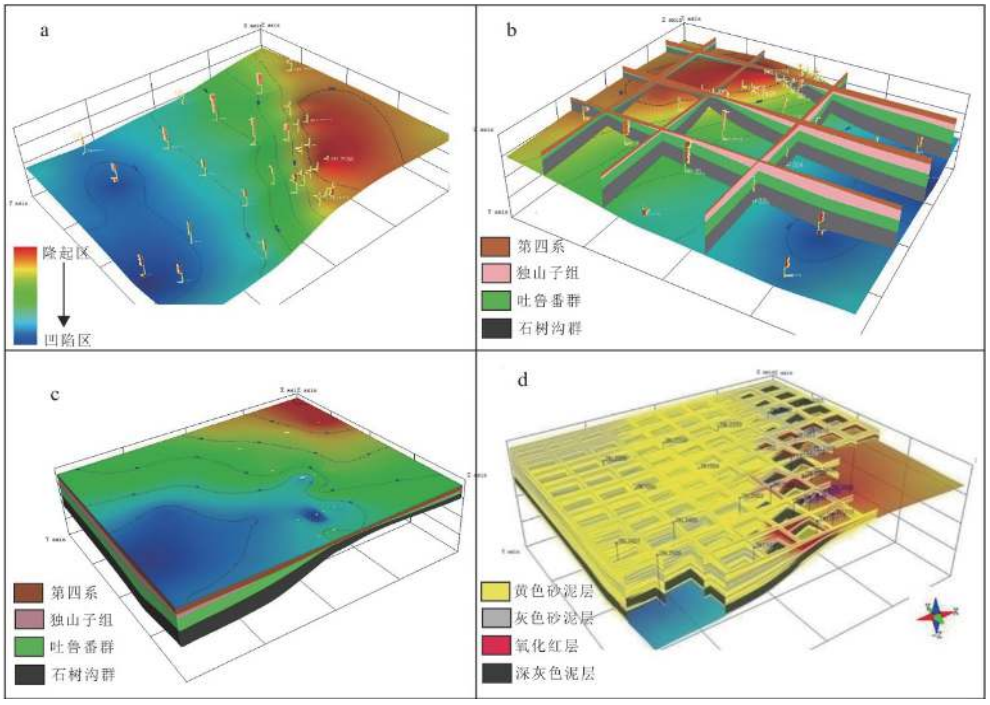

图 4　准噶尔盆地东缘五彩湾地区三维地质结构图

a—准噶尔盆地东缘五彩湾地区的钻孔三维空间展布（显示测区钻孔分布，根据钻孔信息已初步绘制地形走势）；b—准噶尔盆地东缘五彩湾地区的地层分组三维栅格模型（根据钻孔分布及地层顶底深度，初步绘制地层分组三维栅格模型）；c—准噶尔盆地东缘五彩湾地区的地层分组厚度三维空间展布（对地层的厚度及空间展布有更加直观的认识）；d—准噶尔盆地东缘五彩湾地区的地层粒度属性及厚度三维栅格模型（可以认识到砂体在地下的变化趋势，对研究沉积相具有指示意义）

斜西翼的西山窑组为已探明的聚煤成岩储集层，向西逐渐歼灭。本次选取的钻孔未出现西山窑组，无煤层产出。根据钻孔数据集推测，紧邻帐篷沟背斜两翼含有西山窑组的地层为含煤储集层。另外，钻孔数据集中测井曲线信息可以揭示地下自然 γ 异常区展布，未来能为放射性矿产的勘查找矿工作提供支持。

6　结论

本钻孔数据集汇总了准噶尔盆地东缘五彩湾地区的 20 个钻孔的数据信息，涵盖了五彩湾地区帐篷沟背斜西侧的第四系覆盖区。通过提取钻孔资料中的砂体颜色、粒度、顶深、底深、厚度等基本属性建立钻孔数据集并制作三维地质结构图，真实、直观地反映了研究区的沉积结构与沉积特征。数据集建立过程经过多次的人工自检、互检，通过严格的数据质量检查，达到了使用标准。本钻孔数据集可以应用于沉积学的研究工作，有利于地质工作者对研究区的沉积结构和沉积特征有更加直观地解读。

致谢：对中国地质调查局天津地质调查中心王惠初教授级高工和野外奋战一线的同志们一并表示感谢。

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Dataset of Boreholes Drilled in the Coalfield of Wucaiwan Area in Eastern Margin of Junggar Basin, Xinjiang

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Abstract: Junggar Basin in Xinjiang is an important home to reservoirs of energy and mineral resources such as oil, gas, and coal in China. In this paper, a dataset of 20 boreholes drilled in the coalfield of Wucaiwan area that lies in the eastern margin of Junggar Basin (also referred to as the Dataset) was established based on secondary development and exploitation of existing borehole materials. In other words, the Dataset was established by extracting important information from existing materials of the boreholes such as coordinates and elevation of boreholes, thickness and color of strata discovered, and data from interpretation of logging curves. It consists of Excel database files of 20 boreholes. Each database file is comprised of 10 worksheets, namely *Basic information of boreholes*, *Lithological beds based on logging interpretation*, *Beds based on geological record histogram, Beds based on comprehensive histogram*, *Lithological beds of boreholes*, *Names and codes of strata, Colors of beds*, *Configuration oflogging curves*, *Data from logging curves*, and *Data dictionary*. The data in the Dataset can be read using software developed by Xi'an Shiwen Software Co., Ltd. (also referred to as Shiwen software) to plot 3D stereograms of stratigraphic sedimentary. This will help achieve a more intuitive understanding of the spatial distribution and 3D geological structures of sandstone bodies in Wucaiwan area and thus is significant for the research of the sedimentary environment in this area.

Key words: Junggar Basin; Wucaiwan area; boreholes drilled in coalfield; sedimentary strata; Dataset

Data service system URL: http://dcc.cgs.gov.cn

1 Introduction

It is important to establish databases of the boreholes drilled in important basins of energy

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in north China such as Edors, Songliao, and Erlian basins based on secondary development of existing borehole materials. The databases will be significant for understanding of the distribution of sedimentary strata and 3D geological structures in these regions and also serve as guidance on exploration of energy and mineral resources in these regions (Zhang TF et al., 2016, 2018, 2019; Feng XX et al., 2019; Tang C et al., 2018; Wei JL et al., 2018). Junggar Basin is located in north Xinjiang. It is sandwiched between Tianshan Mountains in the south and Altai Mountains in the north, with Junggar Boundary Mountain as its western and eastern boundaries. It is roughly triangular in shape, with an area of about 1.3×10^5 km^2. As a Late Carboniferous –Quaternary sedimentary basin developing from the Junggar block, it is an important basin of oil, gas, and coal resources in northwest China (Wang T et al., 2012; Chen FJ et al., 2005; Yang YX et al., 2010). The Jurassic sedimentary strata in the eastern margin of Junggar Basin serve as important reservoirs of resources such as oil, gas, and coal (Li M et al., 2014; Bao ZD et al., 2011; Han SH et al., 2012). Establishing borehole databases will be of indicative significance for understanding of 3D geological structures and sedimentary environment of Junggar Basin and for further exploration of energy and mineral resources in this basin. To explore resources such as oil and gas and coals in Junggar Basin, a great number of boreholes have been drilled and extensive borehole data have been accumulated by previous researchers for many years. In this paper, the dataset of the boreholes drilled in the coalfield of Wucaiwan area in the eastern margin of Junggar Basin was established, which will be significant for understanding of the spatial distribution, 3D geological structures, and the paleo-sedimentary environment of sandstone bodies in Wucaiwan area (Fig. 1).

The Dataset was established based on drilling data obtained by previous researchers and therefore, it is an achievement of secondary development of existing borehole data. To give full attention to existing borehole data, exhaustive borehole data obtained by previous scholars were collected (Ruan CM et al., 2008). Important borehole data related to coalfields and oil were sorted, scanned, converted with regard to data types, input, and integrated according to uniform standards and requirements (Zhou XX et al., 2016). In this way, the borehole database was established.

The Dataset (Cheng XY et al., 2020) consists of Excel database files of 20 boreholes. Each of these files is comprised of 10 worksheets, namely *Basic information of boreholes*, *Lithological beds based on logging interpretation*, *Beds based on geological record histogram*, *Beds based on comprehensive histogram*, *Lithological beds of boreholes*, *Names and codes of strata*, *Colors of beds*, C*onfiguration of logging curves, Data from logging curves*, and *Data dictionary*.

The brief metadata table of the Dataset is shown in Table 1.

2 Methods for Data Acquisition and Processing

2.1 Data Source

The data of 20 boreholes drilled in the coalfield of Wucaiwan area were collected from the Geological Archives of Xinjiang Uygur Autonomous Region. The 20 boreholes were drilled under Open-pit Mine Exploration Project in Wucaiwan Mining Area in Jimsar County

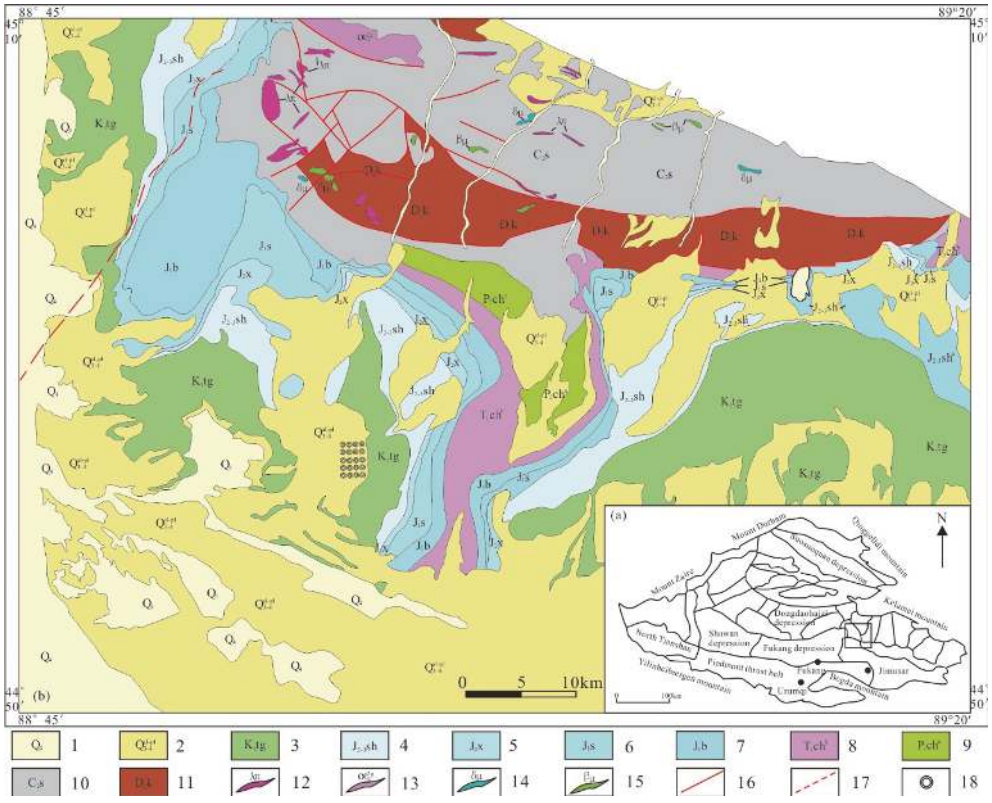

Fig. 1 Geological map and borehole locations of Wucaiwan area in the eastern margin of Junggar Basin

1—Quaternary aeolian sand; 2—Quaternary alluvium and diluvium; 3—Early Cretaceous Tugulu Group; 4—Mid–Late Jurassic Shishugou Group; 5—Middle Jurassic Xishanyao Formation; 6—Early Jurassic Sangonghe Formation; 7—Early Jurassic Badaowan Formation; 8—Early Triassic Shangcangfanggou Group; 9—Late Permian Xiacangfanggou Group; 10—Middle Carboniferous Shiqiantan Group; 11—Middle Devonian Kelameili Group; 12—Fine-grained diorite; 13—Quartz nephelinite; 14—Diorite porphyry; 15—Diabase; 16—Fault; 17—Inferred fault; 18—Borehole

of Coalfields in the Eastern Margin of Junggar Basin, Xinjiang undertaken by Shendong Tianlong Group Co., Ltd. Their numbers are ZK001, ZK002, ZK003, ZK0101, ZK0107, ZK0108, ZK0109, ZK0201, ZK0202, ZK0203, ZK0204, ZK0205, ZK0206, ZK0207, ZK0208, ZK0209, ZK0210, ZK0301, ZK0306, and ZK0307. Important information was extracted from borehole data, including borehole coordinates and the data of sandstone bodies in strata such as thickness, depth of top and bottom, color, and grain size. In this manner, the data of Excel database were formed.

2.2 Data Processing

2.2.1 Data Preparation

Borehole data can be used to reveal the sequence and rock and earth mass types of regional strata, thus providing geological data and information for the building of regional 3D geological models (Sun QY et al., 2018, 2019). In this paper, *Histogram of Boreholes* and *Diagram of Comprehensive Logging Results* were gathered for data extraction. Files such as exploration reports and regional geological maps were saved in a folder named “Others”.

Table 1 Metadata Table of Database (Dataset)

Items	Description
Database (dataset) name	Dataset of Boreholes Drilled in the Coalfield of Wucaiwan Area in Eastern Margin of Junggar Basin, Xinjiang
Database (dataset) authors	Cheng Xianyu, Tianjin Center, China Geological Survey Zhang Tianfu, Tianjin Center, China Geological Survey
Data acquisition time	2019
Geographical area	Wucaiwan Town, Jimsar County, Changji Hui Autonomous Prefecture, Xinjiang Uygur Autonomous Region
Data format	*.xls
Data size	8.94 MB
Data service system URL	http://dcc.cgs.gov.cn
Fund projects	Project to Survey Mineral Resources Such as Uranium and Thorium in Tianshan-North China Continental Block (No.: DD20190813)
Language	Chinese
Database (dataset) composition	The Dataset consists of Excel database files of 20 boreholes with numbers of ZK001, ZK002, ZK003, ZK0101, ZK0107, ZK0108, ZK0109, ZK0201, ZK0202, ZK0203, ZK0204, ZK0205, ZK0206, ZK0207, ZK0208, ZK0209, ZK0210, ZK0301, ZK0306, and ZK0307. Each of these files is comprised of 10 worksheets, namely *Basic information of boreholes*, *Lithological beds based on logging interpretation*, *Beds based on geological record histogram*, *Beds based on comprehensive histogram*, *Lithological beds of boreholes*, *Names and codes of strata*, *Colors of beds*, *Configuration of logging curves*, *Data from logging curves*, and *Data dictionary*.

2.2.2 Data Extraction

Useful data were extracted from *Histogram of Boreholes* and *Diagram of Comprehensive Logging Results* in order to establish the Dataset.

(1) Information extracted from the *Histogram of Boreholes* mainly includes borehole coordinates, scale, information on formations and members of strata, lithological division of strata, depth of top and bottom of strata, and thickness and colors of sandstone bodies.

(2) Data of gamma logging curves were mainly extracted from the *Diagram of Comprehensive Logging Results*. Shiwen software named GraphToDigital was used to convert the gamma logging curves into numerical values since the logging curves were in.jpg format. The detailed operation process is as follows. ① Open the software and then open the *Diagram of Comprehensive Logging Results* through the menu "File". Provide initial values of upper, lower, right, and left limits of the curve for data extraction. Then read relevant values and fill them in the interface. ② Select the color of the curve to be tracked. Then start tracking, during which a tracking curve will form and should be finely adjusted to make it as consistent with the original curve as possible. Finally, export the numerical data. The operation interface is shown in Fig. 2. ③ The data exported is in.txt format and should be converted to.xls format.

3 Description of Data Samples

Each Excel database consists of 10 worksheets, of which seven are required and three are

Fig. 2 Operation interface of GraphToDigital software

optional. The seven required to be filled include *Basic information of boreholes*, *Lithological beds based on logging interpretation*, *Beds based on comprehensive histogram*, *Names and codes of strata*, *Colors of beds*, *Configuration of logging curves*, and *Data from logging curves*. The remaining three worksheets, *Beds based on geological record histogram, Lithological beds of boreholes*, and *Data dictionary*, are optional. The logical structure of a database is shown in Fig. 3. As there are many items in each worksheet, only required items are listed in Tables 2–8 (sample data listed in Tables 2–8 are extracted from the dataset DD20190813-3ZK001.xlsx). The databases must be filled in strict accordance with the templates. Otherwise, the data therein cannot be read by Shiwen software.

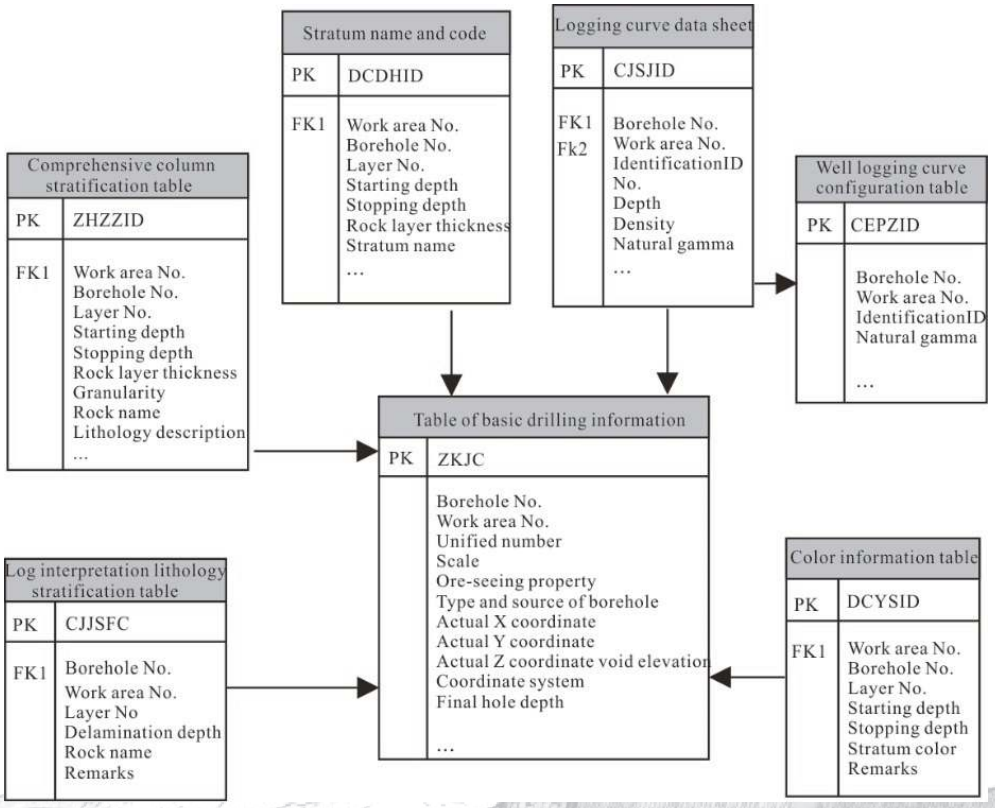

Fig. 3 Logic structure diagram of the Database

Table 2 Basic information of boreholes (TABLE_ZKJC)

Work area No.	Borehole No.	Uniform No.	Scale	Ore-discovery property	Borehole type and source	Actual X coordinate	Actual Y coordinate	Actual Z coordinate/ borehole head elevation	Coordinate system	Final hole depth/m
GQBH	TKALA	PKIAA	BLC	JKXZ	ZKLX	TKCAF	TKCAG	TKCAI	ZBX	TKACCA
DD20190813-3	ZK001	DD20190813-3ZK001	1∶500	2	1	4958552.446	30420439.933	484.755	Xi'an 1980	420.42

Table 3 Lithological beds based on logging interpretation (TABLE_CJJSFC)

Work area No.	Borehole No.	Bed No.	Bed depth/m	Rock name
GQBH	TKALA	GGON	MDBFND	YSEB
DD20190813-3	ZK001	1	37.16	Conglomerate
DD20190813-3	ZK001	2	52.64	Mudstone
DD20190813-3	ZK001	3	184.05	Siltstone
DD20190813-3	ZK001	4	232.21	Fine sandstone
DD20190813-3	ZK001	5	276.47	Siltstone
DD20190813-3	ZK001	6	277.10	Conglomerate
DD20190813-3	ZK001	7	283.01	Mudstone
DD20190813-3	ZK001	8	293.76	Argillaceous siltstone
DD20190813-3	ZK001	9	298.05	Medium sandstone
DD20190813-3	ZK001	10	307.29	Silty mudstone

Table 4 Beds based on comprehensive histogram (TABLE_ZHZZFC)

Work area No.	Borehole No.	Bed No.	Start depth/m	End depth/m	Bed thickness/m	Constituent particle	Rock name	Lithological description
GQBH	TKALA	GGON	TKYXQ	TKYXZ	YSFCHD	YXLD	YSEB	YXMS
DD20190813-3	ZK001	1	0.00	37.16	37.16	Gravel	Conglomerate	Conglomerate
DD20190813-3	ZK001	2	37.16	52.64	15.48	Mud	Mudstone	Mudstone
DD20190813-3	ZK001	3	52.64	184.05	131.41	Silty sand	Siltstone	Siltstone
DD20190813-3	ZK001	4	184.05	232.21	48.16	Fine sand	Fine sandstone	Fine sandstone
DD20190813-3	ZK001	5	232.21	276.47	44.26	Silty sand	siltstone	siltstone
DD20190813-3	ZK001	6	276.47	277.10	0.63	Gravel	Conglomerate	Conglomerate
DD20190813-3	ZK001	7	277.10	283.01	5.91	Mud	mudstone	mudstone
DD20190813-3	ZK001	8	283.01	293.76	10.75	Silty sand	argillaceous siltstone	argillaceous siltstone
DD20190813-3	ZK001	9	293.76	298.05	4.29	Medium sand	Medium sandstone	Medium sandstone
DD20190813-3	ZK001	10	298.05	307.29	9.24	Mud	Silty mudstone	Silty mudstone

4 Data Quality Control and Assessment

The data of the boreholes drilled in the coalfield of Wucaiwan area were derived from the exploration report of Open-pit Mine Exploration Project in Wucaiwan Mining Area in Jimsar County of Coalfields in the Eastern Margin of Junggar Basin, Xinjiang that was submitted by Shendong Tianlong Group Co., Ltd. in 2018. They were gathered from Geological Archives of Xinjiang Uygur Autonomous Region, and they are results collected by previous researchers in

Table 5 Names and codes of strata (TABLE_DCDH)

Work area No.	Borehole No.	Stratum No.	Start depth/m	End depth/m	Stratum code	Name of lithostratigraphic unit
GQBH	TKALA	GGON	TKDCQ	TKDCZ	DCDH	DSBF
DD20190813-3	ZK001	1	0.00	37.16	Q	Quaternary
DD20190813-3	ZK001	2	37.16	52.64	N#-2#=d	Dushanzi Formation
DD20190813-3	ZK001	3	52.64	277.10	K#-1#=tg	Tugulu Group
DD20190813-3	ZK001	4	227.10	333.27	J#-2-3#=sh	Shishugou Group

Table 6 Colors of beds (TABLE_DCYS)

Work area No.	Borehole No.	Bed No.	Start depth/m	End depth/m	Bed color
GQBH	TKALA	GGON	TKYSQ	TKYSZ	YSHB
DD20190813-3	ZK001	1	0.00	37.16	Grayish yellow
DD20190813-3	ZK001	2	37.16	52.64	Brick red
DD20190813-3	ZK001	3	52.64	184.05	Rufous
DD20190813-3	ZK001	4	184.05	232.21	Grayish green
DD20190813-3	ZK001	5	232.21	276.47	Rufous
DD20190813-3	ZK001	6	276.47	277.10	Brown
DD20190813-3	ZK001	7	277.10	283.01	Amaranthine
DD20190813-3	ZK001	8	283.01	293.76	Amaranthine
DD20190813-3	ZK001	9	293.76	298.05	Grayish green
DD20190813-3	ZK001	10	298.05	307.29	Amaranthine

Table 7 Configuration of logging curves (TABLE_CJQXPZ)

Work area No./GQBH	Borehole No./TKALA	ID/PRECID	Gamma ray unit/ZRGMDW
DD20190813-3	ZK001	1	API

Table 8 Data from logging curves (TABLE_CJQXSJ)

Work area No./GQBH	Borehole No./TKALA	ID/ PRECID	Code/ GGON	Depth/ DMZKSD	Gamma ray intensity/ZRGM
DD20190813-3	ZK001	1	1	0.3500	18.67
DD20190813-3	ZK001	1	2	0.4000	19.05
DD20190813-3	ZK001	1	3	0.4500	19.94
DD20190813-3	ZK001	1	4	0.5000	20.25
DD20190813-3	ZK001	1	5	0.5500	20.25
DD20190813-3	ZK001	1	6	0.6000	20.13
DD20190813-3	ZK001	1	7	0.6500	19.56
DD20190813-3	ZK001	1	8	0.7000	18.67
DD20190813-3	ZK001	1	9	0.7500	18.10
DD20190813-3	ZK001	1	10	0.8000	17.27

accordance with relevant national regulations and provisions. Thus the Dataset was an achievement of the secondary development of foregoing information and data. During data extraction, the requirements of quality inspection were satisfied by multiple manual self-checks

and mutual-checks. Only in this way can data be normally read from the Dataset by Shiwen software, named Gxplorer. Maps of the 3D geological structure of Wucaiwan area were plotted after date reading (Fig. 4), which can more intuitively reflect the sedimentary characteristics and structures of this area.

5 Data Value

The Dataset was established for two purposes. One is for plotting 3D geological structure maps of the work areas in order to display the sedimentary characteristics of the areas in a more intuitive way. The other is for digging out more meaningful information through data integration in order to interpret critical geological problems in the relevant areas. The boreholes involved in this paper are located in the west wing of Zhangpenggou anticline in Wucaiwan area. In the case of regional topography (Fig. 4a), depression and uplift tend to form in the west and east respectively; the strata have good extensibility, with no formations and members found missing and sandstone bodies evenly distributed, and the sediments in this area are thin in the upper part and thick in the lower part in general (Fig. 4b, c), indicating that the area experienced a stable sedimentary environment; the strata are mainly yellow sands, interbedded

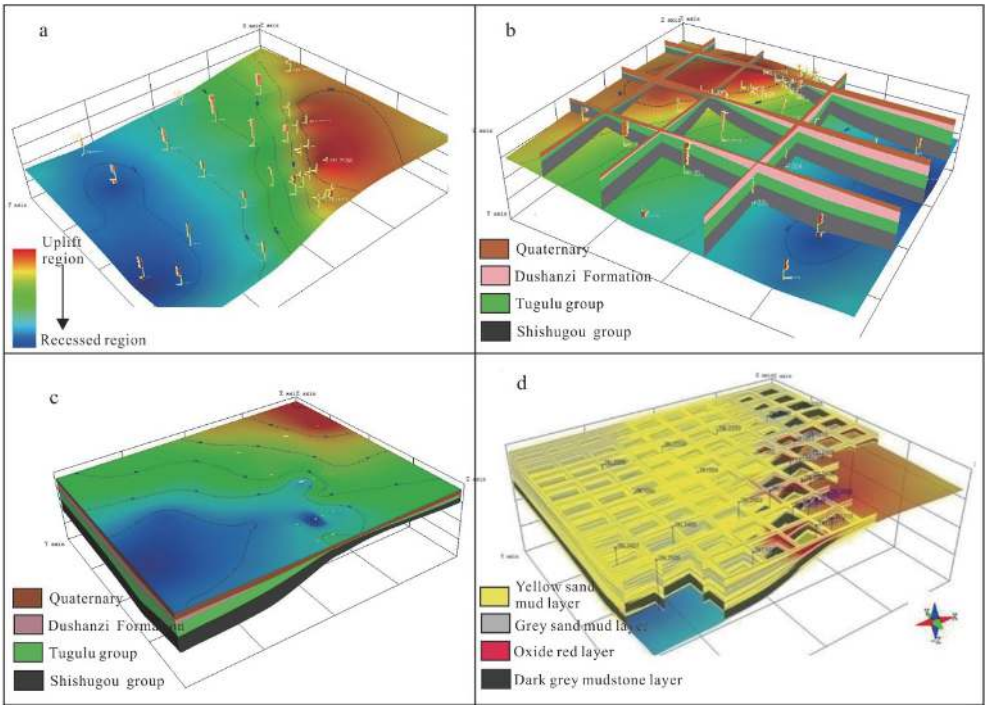

Fig. 4 Maps of 3D geological structure of Wucaiwan area in the eastern margin of Junggar Basin

a—3D spatial distribution of boreholes in Wucaiwan area in the eastern margin of Junggar Basin (used to display the distribution of the boreholes in the survey area. The maps of topographic trend have been preliminarily plotted based on borehole information); b—3D geological raster model of strata in Wucaiwan area in the eastern margin of Junggar Basin (a preliminarily plotted model based on borehole distribution and depth of the stratum top and bottom); c—3D spatial distribution of thickness of strata in Wucaiwan area in the eastern margin of Junggar Basin (contributing to a more intuitive understanding of thickness and spatial distribution of the strata); d—3D geological raster model of constituent particles and thickness of strata in Wucaiwan area in the eastern margin of Junggar Basin (allowing for understanding of the changing trend of sandstone bodies underground and being of indicative significance for research of sedimentary facies)

with thin layered grey sands, and dark grey mudstone at the bottom (Fig. 4d). Xishanyao Formation in the west wing of the Zhangpenggou anticline has been proven to be reservoirs of coals, and it gradually thins out towards the west. Xishanyao Formation was not found in the boreholes selected in this paper and no coal seam was produced. It can be inferred from the Dataset that the strata containing Xishanyao Formation that are closely adjacent to two wings of the Zhangpenggou anticline are coal-bearing reservoirs. Additionally, the distribution of underground abnormal natural gamma-ray areas can be revealed by data from logging curves in the Dataset. This will provide support for future exploration of radioactive minerals.

6 Conclusion

This Dataset consists of data from 20 boreholes that were drilled in Wucaiwan area in the eastern margin of Junggar Basin and cover the Quaternary in the western side of the Zhangpenggou anticline. It was established by extracting basic properties of sandstone bodies from borehole-related information, such as the color, constituent particles, depth of top and bottom, and thickness. Meanwhile, maps of the 3D geological structure of Wucaiwan area were plotted to truly and intuitively reflect the sedimentary structures and characteristics of the area. In establishment of the Dataset, strict requirements of quality inspection were satisfied by multiple manual self-checks and mutual-checks. As a result, the Dataset is practical. This Dataset can be applied in sedimentological research and will help geologists to more intuitively understand the sedimentary structures and characteristics of Wucaiwan area.

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