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海南省龙门市幅 1∶50 000 环境地质调查数据集

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摘要：本数据集为 2017 年在海南省龙门市幅开展的 1∶50 000 环境地质调查的调查信息、水文地质钻孔、地下水采样及化学成分测试结果，包含机民井点 221 个，泉点 21 个，地表水点 7 个，水文地质钻孔 10 个，进尺 808.77 m，地下水全分析采样点 56 个。调查点符合规范要求，钻探施工质量可靠，采样过程规范，测试均由符合资质要求的实验室完成，数据质量可靠。数据集可以真实反映该时段龙门市幅水文地质环境地质条件，并依托调查成果，为地方圈定 1 处地下水后备水源地，可有效缓解季节性缺水问题，为科学合理利用地下水资源提供依据。

关键词：地下水；农业用水；城镇供水；水源地；水文地质调查工程；环境地质调查工程；水化学；数据集；龙门市；海南省

数据服务系统网址：http://dcc.cgs.gov.cn

1　引言

龙门市幅工作区位于海南岛中部偏东北，行政隶属海南省定安县，东经 110°15′～110°30′，北纬 19°20′～19°30′，东临文昌市，西接澄迈县，东南与琼海市毗邻，西南与屯昌县接壤，北隔南渡江与海口市琼山区相望。

海南省属季节性缺水地区，2005 年全省大旱，造成城镇生活用水、农村灌溉用水困难，给海南造成无法估量的损失；2015 年 3 月—6 月，特别是 5 月下旬之后，海南西部和西南部遭受大旱，全省 44 条河道断流，119 座水库干涸，全省 13.26 万人饮水困难，三亚城区供水严重不足，多地出现间歇性断水。目前海南居民生活饮用水和工业用水水源以地表水为主，而季节性干旱、突发事件引起的供水紧张是长期需要面对的问题，海南目前全省尚未建立应急供水系统，供水安全保障程度低。通过开展 1∶50 000 环境地质调查，在查明工作区水文地质环境地质条件的基础上，圈划出 1 处地下水后备水源地，有效缓解地方季节性缺水问题。

龙门市幅 1∶50 000 环境地质调查数据集的基本信息简介见表 1。

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表 1　数据库 (集) 元数据简表

条目	描述
数据库(集)名称	海南省龙门市幅1：50 000环境地质调查数据集
数据库(集)作者	刘凤梅，中国地质调查局武汉地质调查中心 余绍文，中国地质调查局武汉地质调查中心 张彦鹏，中国地质调查局武汉地质调查中心
数据时间范围	2017年1月—2017年12月
地理区域	海南省定安县
数据格式	.xlsx
数据量	425 KB
数据服务系统网址	http://dcc.cgs.gov.cn
基金项目	中国地质调查局地质调查项目“琼东南经济规划建设区1：50 000环境地质调查”(DD20160259)
语种	中文
数据库(集)组成	该数据集是由14个Excel表格组成，表格名称分别为调查点基础数据表.xlsx、机民井调查表.xlsx、泉点野外调查表.xlsx、野外调查路线表.xlsx、野外地质综合调查表.xlsx、地层岩性界线调查点记录表.xlsx、野外构造点调查表.xlsx、地表水点综合调查表.xlsx、试坑渗水试验观测记录表.xlsx、试坑渗水试验综合成果表.xlsx、野外水样采集记录表.xlsx、水质分析综合成果表.xlsx、钻孔基本情况表.xlsx和钻孔地层描述表.xlsx

2　数据采集和处理方法

2.1　面上调查

调查采用 1：250 000 地形图作为底图，手持 GPS 进行实地定点，对所有的调查点进行了详细的记录和描述，对 1：250 000 区域地质调查的地质地貌界线进行了验证，对有偏差的地质地貌界线进行了修正，各类观测点均符合规范要求。本数据集包括机民井调查点 221 个，泉点 21 个，地表水点 7 个，岩性控制点 77 个，地层界线点 77 个，构造点 3 个，调查线路 38 条。在调查中，用电子水位计读取水位埋深数据，使用三角堰读取地表水、泉水流量数据，使用哈希 HQ40d 和 manta 进行现场水温、pH、电导率和氧化还原电位的测试，保证记录数据的精确。

2.2　水样的采集与分析

本次工作中根据《水质采样样品的保存和管理技术规定》(HJ 493−2009)、《水质采样技术指导》(HJ 494−2009)、《生活饮用水标准检验方法水样的采集和保存》(GB/T 5750.2−2006)制定采样技术要求，并进行水样采集、保存和送样。本数据包含地下水全分析结果 119 个，丰水期 57 个，枯水期 52 个，钻孔水样 10 个。

2.3　钻孔数据采集

所实施钻孔均依据《水文地质调查规范 (1：50 000)》(DZ/T 0282−2015)、《水文水井地质钻探规程》(DZ/T 0148−2014)相关要求进行了数据记录，依据支撑地方政府脱贫攻坚需求，本数据集对钻孔重要信息进行了整理集成，形成地质钻孔基本信息表和钻孔地层描述表。本数据包括 10 个钻孔的基本情况表、钻孔地层描述表。

所有调查点数据均未经处理，皆为现场调查和测试分析数据采集，各调查点分布如图 1 所示。

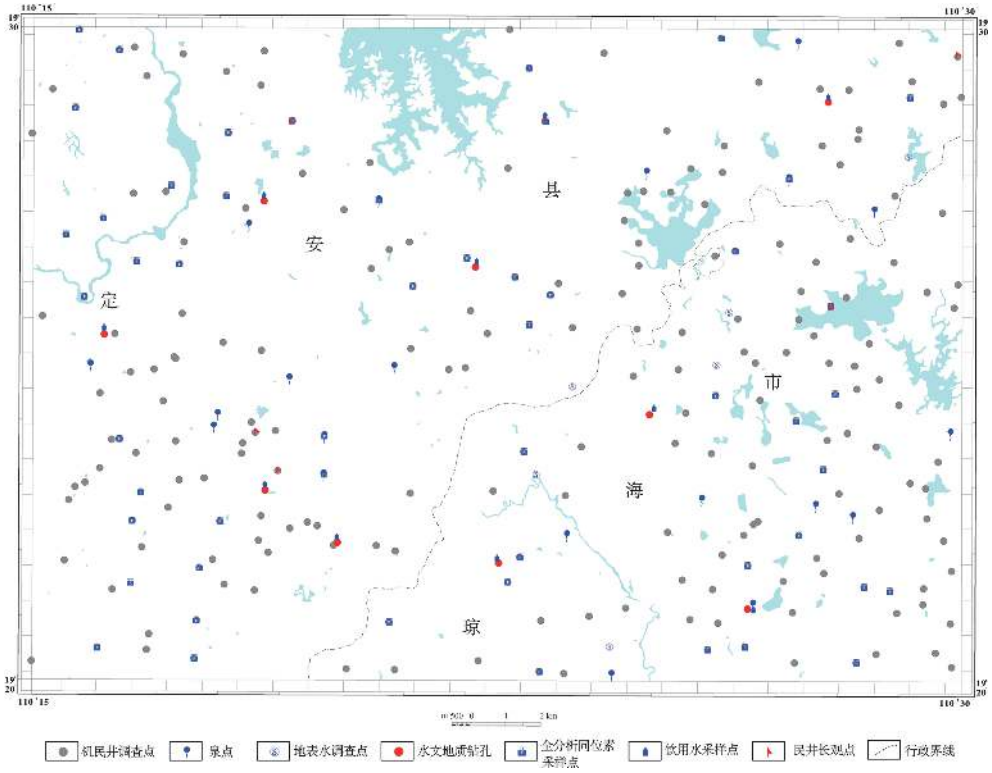

图 1　海南省龙门市幅调查采样点分布图

3　数据样本描述

3.1　调查数据

龙门市幅 1：50 000 环境地质调查数据集为 Excel 表格型数据，包括 10 个 Excel 数据文件，分别为调查点基础数据表.xlsx(表 2)、机民井调查表.xlsx(表 3)、泉点野外调查表.xlsx(表 4)、野外调查路线表.xlsx、野外地质综合调查表.xlsx、地层岩性界线调查点记录表.xlsx、野外构造点调查表.xlsx、地表水点综合调查表.xlsx、试坑渗水试验观测记录表.xlsx、试坑渗水试验综合成果表.xlsx(其他表格内容详见数据集)(各量纲单位为：高程

表 2　龙门市幅环境地质调查点基础数据集例表

字段名称	实例
统一编号	1101543471929577001
路线统一编号	L1
野外编号	D2001
调查点名称	–
经度	110154347
纬度	19295770
X坐标	19422534
Y坐标	2157150
地面高程	68 m
地理位置	海南省定安县龙门镇新安村
图幅编号	龙门市幅，E49E004010
调查点类型	机民井调查点，水样采集点，地质综合调查点，水质现场测试

表 3　机民井调查表数据集例表

字段名称	实例	字段名称	实例
统一编号	11025133419282628O1	浊度	–
野外编号	D2096	气味	无
天气	晴	透明度	透明
经度	110251334	HCO_3^-	–
纬度	19282628	Ca^{2+}	–
地面高程	110 m	*DO*	7.48
地理位置	海南省定安县黄竹镇文星堆村	*EC*	231.3 μs/cm
图幅编号	龙门市幅，E49E004010	*Eh*	268.1 mV
井口高程	110 m	井与地表水距离	–
井口直径	3 700 mm	取水设备及型号	离心泵
井底直径	3 700 mm	是否做过抽水试验	否
地下水位埋深	1 m	成井日期	1986
井的类型	民井	可能污染源类型	农田
井深	10 m	可能污染源距井距离	4 m
井壁结构	石垒	主要用途	生活用水
井淘洗情况	每年	年水位变幅	1
开采方式	间歇开采	是否饮用	是
滤管位置	–	平面位置示意图	(BLOB)
取水层位	中更新统多文组(Qp_2d)	剖面示意图	(BLOB)
地下水的类型	孔隙水	备注	
含水层岩性特征	玄武岩风化残积层	项目名称	琼东南经济规划建设区1：50 000环境地质调查—龙门市幅
取样情况	未取样	调查单位	武汉地质调查中心
开采量	20 m^3/d	调查工作时间	2017-7-9
水温	29.03℃	调查人	梁昌智
pH	7.19	记录人	龚皓
味	无	审核人	余绍文
色度	–	填表时间	2017-7-9
气温	29℃		

m，直径 mm，埋深 m，开采量 m^3/d，温度 ℃，电导率 μS/cm，氧化还原电位 mV，流量 L/s)。

3.2　水样采集测试数据

水样采集测试数据集主要包括 2 个 Excel 数据文件，分别为野外水样采集记录表.xlsx 和水质分析综合成果表.xlsx。

野外水样采集记录表.xlsx 中样品共计 170 个，数据内容主要包括统一编号、野外编号、经度、纬度、X 坐标、Y 坐标、地理位置、地面高程、图幅编号、样品编号、采样时间、样品类型、以往取样、静止水位、水温、*EC*、pH、色、嗅、味、透明度、化学处理方式、平面位置示意图、备注、项目名称、调查单位、采样人、记录人、审核人

表 4　泉点调查表数据集例表

字段名称	实例	字段名称	实例
统一编号	1102034371927216601	透明度	透明
野外编号	D1023	pH	6.35
经度	110203437	取样情况	未取样
纬度	19272166	*Eh*	217 mV
地面高程	93.9 m	*DO*	–
地理位置	海南省定安县龙门镇土地村	电导率	86 μs/cm
泉点名称	–	HCO_3^-	–
图幅编号	龙门市幅，E49E004010	Ca^{2+}	–
泉水类型	下降泉	周围可能的污染源	泉点周边可见丢弃的洗衣袋、报纸等生活垃圾
含水层岩性	玄武岩	含水层特征	–
主要用途	灌溉、洗涤	剖面示意图	(BLOB)
补给来源	大气降水	平面位置示意图	(BLOB)
沉淀物及气体成分	–	备注	照片编号IMG1347-1353、IMG6569-6571
天气	晴	项目名称	琼东南经济规划建设区1：50 000环境地质调查
气温	29℃	照片编号	IMG1347-1353、IMG6569-6571
流量测定方法	三角堰法	调查单位	武汉地质调查中心
泉的流量	0.794 L/s	调查工作时间	2017-6-8
动态变化特征	随旱雨季变化明显	调查人	梁昌智、符策伟
泉水温度	25℃	记录人	汪夏旭
色度	–	审核人	张彦鹏
味	无	填表时间	2017-6-8
气味	无		

等 29 项 (表 5)。

地下水的化学组成是地下水质量评价的重要内容，地下水无机指标是评价地下水质量的直接参数，尤其是氟离子、三氮、重金属等无机毒理指标更是在饮用水评价标准中有着严格的要求（李成柱等，2018；马洪云等，2018）。地下水全分析测试结果表.xlsx 中样品共计 119 个，数据内容主要包括 37 项基本信息 (统一编号、样品编号、室内编号、测试编码、水温、pH、K、Ca、Na、Mg、Sr、Ba、V、Fe、Ni、Zn、Ga、Sn、Ti、Bi、Al、Si、Cr、Cd、Sb、Ti、Mn、As、Be、B、Co、Cu、Li、Pb、F、Cl^-、Br^-、NO_3^-、PO_4^{3-}、SO_4^{2-}等，见表 6，测试结果量纲为 mg/L)。

3.3　钻孔数据

龙门市幅钻孔数据集为 Excel 表格型数据，主要包括 2 个 Excel 数据文件，分别为钻孔基本情况数据集 (表 7)、钻孔地层描述表 (表 8)。

3.4　水化学类型分析

所采集地下水主要以浅层基岩风化层孔隙裂隙水为主，少量基岩裂隙水。地下水水

表 5　水样采集数据集例表

字段名称	实例	字段名称	实例
统一编号	1101531501926491801	EC	394.9 μS/cm
野外编号	D1006	pH	4.67
经度	110153150	色	无
纬度	19264918	嗅	无
X坐标	19422160	味	无
Y坐标	2151354	透明度	透明
地理位置	海南省琼海市龙门镇大船村	化学处理方式	阳离子加浓硝酸
地面高程	85 m	平面位置示意图	(BLOB)
图幅编号	龙门市幅，E49E004010	备注	–
样品编号	LM-FSH001	项目名称	琼东南经济规划建设区1：50 000环境地质调查
采样时间	2017-9-18	调查单位	武汉地质调查中心
样品类型	地下水	采样人	张彦鹏
以往取样	无	记录人	张彦鹏
静止水位	10.69 m	审核人	余绍文
水温	26.43℃		

表 6　水质分析综合成果表数据集例表

字段名称	实例	字段名称	实例
统一编号	1101531501926491801	Zn	0.06
样品编号	LM-FSH001	Cd	0.00
室内编号	D1006	Mn	0.78
测试编码	FSH001	Ni	0.02
水温	26.43	Co	0.02
pH	4.67	总Cr	0.00
铍	0.00	V	0.00
K^+	33.04	Sr	0.05
Na^+	32.71	Sb	0.00
Ca^{2+}	5.73	Fe	0.01
Mg^{2+}	3.23	Tl	0.00
Cl^-	55.51	Ba	0.37
SO_4^{2-}	22.93	B	0.00
NO_3^-	44.90	Br-	0.12
F^-	0.34	As	0.00
PO_4^{3-}	n.a.	Li	0.01
TDS	252.7	Al	0.36
Cu	0.00	取样时间	2017-9-18
Pb	0.00		

化学特征主要受大气降水、岩土体组成及人类活动等多重因素的影响和控制，造成区内地下水水化学类型的复杂性和多样性。根据舒卡列夫分类，区内主要地下水化学类型如

表 7　钻孔基本情况数据集例表

字段名称	实例	字段名称	实例
统一编号	1101609001925173301	含水层初见水位	0.15 m
野外编号	LMSK01	成井深度	101.5 m
经度	110160900	静止水位	3.16 m
纬度	19251733	质量等级	优
X坐标	19423242	含水层特征	砂岩
Y坐标	2148525	平面位置示意图	(BLOB)
地理位置	海南省定安县龙门镇角塘村	钻孔柱状图	(BLOB)
地面高程	91 m	备注	–
图幅编号	龙门市幅，E49E004010	项目名称	琼东南经济规划建设区1：50 000环境地质调查
孔口高程	91 m	施工单位	广东省有色金属地质局水文地质队
钻机类型	XY-1A-4	调查日期	2017-10-31
钻孔类型	水文地质钻探	机长	郑连兵
开孔日期	2017-10-31	地质编录	陈国荣
终孔日期	2017-11-18	记录人	陈国荣
井斜	0	审核人	杨俊烁
开孔直径	168 mm	填表时间	2017-11-18
终孔直径	110 mm	钻孔ID	–
终孔深度	101.5 m		

表 8　钻孔地层描述表

字段名称	实例
统一编号	1101609001925173301
地质时代	K
地层编码	4
场地分层索引号	–
层底标高	84.5 m
层底深度	6.5 m
单层厚度	0.8 m
层底接触关系	–
层理构造	–
岩土名称	强风化砂岩
岩土颜色	上部浅紫红色，下部灰黄色
地层地质描述	细粒结构，层状构造，节理裂隙稍发育，沉积成因，由石英、长石组成，黏土胶结，粒径约0.05～1 mm，局部有水蚀痕迹，透水性一般
钻孔ID	–

表 9 所示。

从表 9 可以看到调查区内浅层地下水总体以低矿化度为主要特征，水化学类型复杂多样。以阴离子划分地下水类型，主要包括 HCO_3 型，$HCO_3 \cdot SO_4$ 型及 Cl 型水，以 HCO_3 型、Cl 型水为主，接近所有样品数量的 92%。以阳离子划分地下水类型，包括

表 9　地下水水化学类型统计

类型	数量	比例
$Ca\text{-}HCO_3$	5	
$Na\text{-}HCO_3$	6	50.00%
$Ca\cdot Na\text{-}HCO_3$	15	
$Ca\cdot Na\text{-}HCO_3\cdot SO_4$	4	7.70%
$Na\cdot Ca\text{-}Cl$	8	
$Na\text{-}Cl$	10	42.30%
$Ca\text{-}Cl$	4	

Ca 型， Na·Ca 型及 Na 型水，以 Na·Ca 型、Na 型水为主，占所有样品数量的 75%。总体上，地下水的水化学类型以 $Ca\cdot Na\text{-}HCO_3$ 型和 Na-Cl 型水为主。

地下水的水化学类型在区域上呈现出山地丘陵区以 HCO_3-Ca 型水为主，靠近剥蚀波状平原区以 Cl 型水为主，具有明显的由山区向平原区演化的规律。同时，地下水类型分布与区域内主要村镇的分布也存在一定的相关性。

4　数据质量控制和评估

4.1　调查点质量控制

1：50 000 龙门市幅环境地质调查，图幅面积约 480 km^2，完成各类调查点 405 个，其中以机 (民) 井调查点和野外地质综合调查点为主，分别为 221 个和 77 个，占调查点的 55% 和 19%，其他调查点分别为地质界线点 77 个，地表水调查点 7 个，泉点 21 个，构造调查点 3 个，平均每百平方公里调查点约 84 个，达复杂地区山地丘陵地区调查点密度；调查线路间距 1 000 ~ 1 200 m，达中等复杂地区要求；完成 10 个水文地质调查孔的抽水试验；水位统测点 56 个，水质分析取样点 56 个，满足《水文地质调查规范 (1：50 000)》(DZ/T 0282−2015) 中对山地丘陵复杂地区每百平方公里水质分析点定额的要求。

4.2　样品采集测试质量控制

样品采集和送检工作严格按照《地下水污染调查规范》要求执行，样品采集点主要布置在水文地质调查点 (机井、民井、集中供水水源地水源井)。采样前作好采样计划，并与承担检测任务的实验室及时做好沟通；在样品采集现场及时填写了记录表和采样标签；现场测试指标均在现场测试，样品按规范要求加相应的保护剂。

样品测试单位均具备相关测试资质的单位，根据项目需求，所有测试方法的技术参数均达到或优于相应标准。

4.3　钻孔数据质量控制

钻孔施工符合相关技术要求及项目需求，抽水试验稳定时长符合规范，抽水曲线正常，获取的各项数据真实可靠，符合工作区实际情况。

5　结论

本数据集包含了 2017 年龙门市幅 1：50 000 环境地质调查的调查数据、样品采集分析数据和钻孔数据，各项工作均符合相关规范要求，获取的数据质量可靠，可以真实

反映该时段龙门市幅水文地质环境地质状况，在此基础上，为地方圈定 1 处地下水后备水源地，可有效缓解季节性缺水问题。

致谢：感谢项目组及海南地质调查院等兄弟单位在获取野外调查数据过程中付出的辛劳和提供的帮助。感谢质量检查和野外验收专家组对调查工作提出的宝贵建议。感谢审稿人和编辑部在稿件修改过程中提出的宝贵建设性意见。

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Dataset of the Environmental Geological Survey on a Scale of 1∶50 000 in the Longmen Map Sheet, Hainan Province

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Abstract: The dataset of the environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet, Hainan Province in 2017 (also referred to as the Dataset) contains the survey information, data of hydrogeological boreholes, groundwater sampling information and the chemical component of the test results from the groundwater samples, which include 221 pumping (domestic) well points, 21 spring points, 7 surface water points, 10 hydrogeological boreholes, 808.77 m footage, and 56 groundwater full analysis sampling points. The data in the Dataset are credible since the survey points are consistent with applicable specifications, drilling quality is credible, the sampling conforms to relevant standards and the samples were tested in qualified labs. Therefore, the Dataset can faithfully reflect the hydrogeological and environmental geological conditions in the Longmen Map Sheet during the survey period. Furthermore, a backup groundwater source was delineated based on the survey results, making it possible to effectively alleviate the seasonal shortage of water and provide a basis for scientific and rational utilization of the groundwater resources.

Key words: groundwater; agricultural water; town water supply; water source; hydrogeological survey engineering; environmental geological engineering; hydrochemistry; dataset; Longmen City; Hainan

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

1 Introduction

The Longmen Map Sheet is located in the northeast of central Hainan and affiliated to Ding'an County, Hainan Province administratively, with the coordinates of 110°15′–110°30′

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EL and 19°20′–19°30′ NL. It borders Wenchang City in the east, Chengmai County in the west, Qionghai City in the southeast and Tunchang County in the southwest. Meanwhile, it is separated from Qiongshan District, Haikou City by the Nandujiang River.

Hainan Province lies in a region sustaining seasonal shortage of water. In 2005, severe drought across the whole province triggering a shortage of water for daily usage in towns and cities and for irrigation in rural areas, causing great loss to the province. During March – June in 2015, especially from late May to June, a great drought struck the west and southwest of Hainan Province, resulting in zero flow in 44 river channels, 119 reservoirs running dry, 132 600 people suffering from shortage of drinking water, seriously insufficient water supply in the urban area of Sanya City and intermittent water supply in many areas. Currently, surface water is the main source of drinking water for the residents and the water source for industrial uses in Hainan Province and, therefore, the province suffers from the shortage of water supply arising from seasonal droughts and unforeseen events for a long term. Furthermore, there is still no emergency water supply system up to now. Therefore, the water supply security in Hainan Province is at a low degree. Through the environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet, the hydrogeological and environmental geological conditions of the area were ascertained. Moreover, a backup groundwater source was delineated based on the survey results, effectively alleviating the seasonal water shortage in the area.

The basic information on the Dataset is shown in Table 1.

2 Methods for Data Acquisition and Processing

2.1 Regional Survey

A topographical map on a scale of 1∶250 000 was taken as a base map, all survey points were positioned with a portable GPS device and they were recorded and described in detail. Furthermore, the geological and topographical boundaries obtained from the regional geological survey on a scale of 1∶250 000 were verified and any with errors were all corrected. As a result, all observation points are compliant with the applicable specifications and codes. The dataset involves 221 pumping (domestic) well points, 21 spring points, 7 surface water points, 77 lithologic control points, 77 stratigraphic boundary points, 3 geological structural points and 38 survey routes. During the survey, electronic water level gauges were adopted to determine the burial depth of water level; triangular weirs were used to measure the flow of surface water and spring water; and HACH HQ40d and Eureka Manta were adopted to test the temperature, pH, electrical conductivity (*EC*) and oxidation-reduction potential (*Eh*) of water, ensuring that the data obtained are accurate.

2.2 Collection and Analysis of Water Samples

The *Water Quality Sampling – Technical Regulation of Preservation and Handling of Water Samples* (HJ 493–2009), *Water Quality – Guidance on Sampling Techniques* (HJ 494–2009) and *Standard Examination Methods for Drinking Water – Collection and*

Table 1 Metadata Table of Database (Dataset)

Items	Description
Database (dataset) name	Dataset of the Environmental Geological survey on a scale of 1∶50 000 in the Longmen Map sheet, Hainan Province
Database (dataset) authors	Liu Fengmei, Wuhan Center, China Geological survey Yu shaowen, Wuhan Center, China Geological survey Zhang Yanpeng, Wuhan Center, China Geological survey
Data acquisition time	January – December in 2017
Geographic area	Ding'an County, Hainan Province
Data format	.xlsx
Data size	425 KB
Data service system URL	http://dcc.cgs.gov.cn
Fund project	China Geological survey project titled "Environmental Geological survey on a scale of 1∶50 000 in the Economic Planning and Construction Zone of southeast Hainan" (DD20160259)
Language	Chinese
Database (dataset) composition	The dataset consists of 14 data tables in Excel, namely "Basic data of survey points.xlsx", Pumping (domestic) well survey.xlsx", "Field survey of spring points.xlsx", "Field survey routes.xlsx", "Field comprehensive geological survey.xlsx", "Survey point records of stratigraphic lithologic boundary.xlsx", "Survey of field geological structural points.xlsx", "Comprehensive survey of surface water points.xlsx", "Observation records of permeability test in trial pits.xlsx", "Comprehensive results of permeability test in trial pits.xlsx", "Records of field water sampling.xlsx", "Comprehensive results of water quality analysis.xlsx", "Basic information of boreholes.xlsx" and "Description of strata revealed by boreholes.xlsx".

Preservation of Water Samples (GB/T 5750.2–2006) were followed in order to determine the technical requirements of water sampling and the collection, preservation and presentation for testing the water samples. The Dataset contains the results of complete chemical analysis of groundwater for 119 water samples, in which 57 were taken during the wet season, 52 were collected during the dry season and 10 were obtained from boreholes.

2.3 Acquisition of Borehole Data

The data of boreholes were recorded in accordance with *Specification for Hydrogeological Survey* (1∶50 000) (DZ/T 0282–2015) and *Specification for Hydrological Well Drilling* (DZ/T 0148–2014) and the important data from the boreholes were collated and integrated based on the demand of local governments for poverty alleviation. As a result, the data tables of basic borehole information and the strata description revealed by boreholes were developed, in which 10 boreholes were covered.

The data of all survey points are unprocessed, which are all collected from field surveys and test analysis data. The distribution of the surveying and sampling points in the Longmen Map Sheet is shown in Fig. 1.

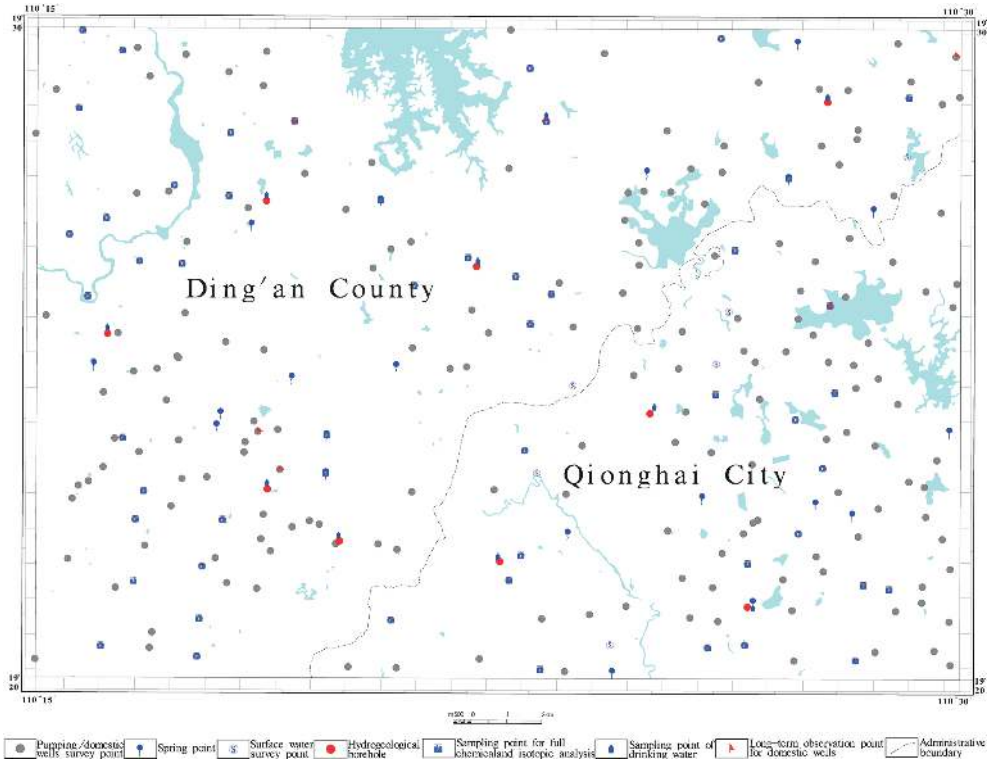

Fig. 1 Distribution of the surveying and sampling sites in the Longmen Map Sheet, Hainan Province

3 Description of Data Samples

3.1 Survey Data

The geological survey data in the Dataset contains 10 data tables in Excel, named "Basic data of survey points.xlsx" (Table 2), "Pumping (domestic) well survey.xlsx" (Table 3), "Field survey of spring points.xlsx" (Table 4), "Field survey routes.xlsx", "Field comprehensive geological survey.xlsx", "Survey point records of stratigraphic lithologic boundary.xlsx",

Table 2 Real Example of "Basic data of survey points.xlsx" in the Dataset

Field name	Real Example
Unified No.	1101543471929577001
Unified No. of route	L1
Field No.	D2001
Survey point name	
Longitude	110154347
Latitude	19295770
Coordinate X	19422534
Coordinate Y	2157150
Ground elevation	68 m
Geographical location	Xin'an Village, Longmen Town, Ding'an County, Hainan Province
Map Sheet No.	Longmen Map Sheet, No.: E49E004010
Survey point type	Pumping (domestic) well survey point, water sampling point, comprehensive geological survey point, water-quality on-site testing

Table 3 Real Example of "Pumping (domestic) well survey.xlsx" in the Dataset

Field name	Real Example	Field name	Real Example
Unified No.	1102513341928262801	Turbidity	–
Field No.	D2096	Odor	Odorless
Weather	Sunny	Transparency	Transparent
Longitude	110251334	HCO_3^-	–
Latitude	19282628	Ca^{2+}	–
Ground elevation	110 m	*DO*	7.48
Geographical location	Wenxingdui Village, Huangzhu Town, Ding'an County, Hainan Province	*EC*	231.3 μS/cm
Map sheet No.	Longmen Map Sheet, No.: E49E004010	*Eh*	268.1 mV
Wellhead elevation	110 m	Distance from wellhead to surface water	–
Wellhead diameter	3 700 mm	Device and model for water intaking	Centrifugal pump
Well bottom diameter	3 700 mm	Pumping test	No
Burial depth of groundwater level	1 m	Date of well completion	1986
Well type	Domestic well	Possible type of pollution source	Farmland
Well depth	10 m	Distance from well to the possible pollution source	4 m
Well wall structure	Built with stones	Main purposes	For daily usage
Elutriation type of well	Yearly	Annual change amplitude of water level	1
Exploitation method	Intermittent exploitation	Whether for drinking use	Yes
Location of screen pipe	–	Planimetric location sketch	(BLOB)
Water-intaking stratum	Duowen Formation of Middle Pleistocene (Qp_2d)	Profile sketch	(BLOB)
Groundwater Type	Pore water	Remarks	
Lithologic feature of aquifer	Basalt-weathered eluvium	Project title	Environmental Geological Survey on a scale of 1∶50 000 in the Economic Planning and Construction Zone in Southeast Hainan — Longmen Map Sheet
Sampling	No sample taken	Undertaken by	Wuhan Center, China Geological Survey
Exploitation volume	20 m^3/d	Date of survey	July 9, 2017
Water temperature	29.03°C	Surveyed by	Liang Changzhi
pH	7.19	Recorded by	Gong Hao
Taste	Tasteless	Checked by	Yu Shaowen
Chroma	–	Filled on (date)	July 9, 2017
Atmospheric temperature	29°C		

Table 4 Real Example of "Field survey of spring points.xlsx" in the Dataset

Field name	Real Example	Field name	Real Example
Unified No.	1102034371927216601	Transparency	Transparent
Field No.	D1023	pH	6.35
Longitude	110203437	Sampling	No sample taken
Latitude	19272166	*Eh*	217 mV
Ground elevation	93.9 m	*DO*	–
Geographical location	Tudi Village, Longmen Town, Ding'an County, Hainan Province	*EC*	86 μS/cm
Spring point Name	–	HCO_3^-	–
Map sheet No.	Longmen Map Sheet, No.: E49E004010	Ca^{2+}	–
Spring type	Gravity spring	Possible pollution sources beside the spring point	Domestic waste discarded visible around the spring point, such as laundry bags and newspaper
Lithology of aquifer	Basalt	Aquifer feature	–
Main purposes	For irrigation and washing	Profile sketch	(BLOB)
Source of recharge	Meteoric precipitation	Sketch of planimetric position	(BLOB)
Composition of sediments and gases	–	Remarks	Picture numbers: IMG1347-1353 and IMG6569-6571
Weather	Sunny	Project title	Environmental Geological Survey on a scale of 1∶50 000 in Economic Planning and Construction Zone of Southeast Hainan
Atmospheric temperature	29	Picture numbers	IMG1347-1353 and IMG6569-6571
Method for measuring water flow	Triangular weir	Undertaken by	Wuhan Center, China Geological Survey
Water flow	0.794 L/s	Date of survey	June 8, 2017
Dynamic change feature	Vary greatly between wet and dry seasons	Surveyed by	Liang Changzhi, Fu Cewei
Water temperature	25℃	Recorded by	Wang Xiaxu
Chroma	–	Checked by	Zhang Yanpeng
Taste	Tasteless	Filled on (date)	June 8, 2017
Odor	Odorless		

"Survey of field geological structural points.xlsx", "Comprehensive survey of surface water points.xlsx", "Observation records of permeability test in trial pits.xlsx" and "Comprehensive results of permeability test in trial pits.xlsx" (see the Dataset for details of other data tables; the units are as follows: elevation - m, diameter - mm, burial depth - m, recovered volume - m^3/d, temperature: °C, *EC* (electronic conductivity) - μS/cm, *Eh* (oxidation-reduction potential) - mV and flow - L/s).

3.2 Data on Collection and Testing of Water Samples

The data of collection and testing of the water samples in the Dataset includes two data tables in Excel, named "Records of field water sampling.xlsx" and "Comprehensive results of water quality analysis.xlsx".

"Records of field water sampling.xlsx" covers 170 samples in total and contains 29 data items in total, which are: unified No., field No., longitude, latitude, X and Y coordinates, geographical location, ground elevation, map sheet No., sample No., sampling date, sample type, previous sampling, static water level, water temperature, *EC*, pH, color, odor, taste, transparency, chemical treatment means, sketch of planimetric position, remarks, project title, survey entity, and the person in charge of sampling, recording and check (Table 5).

The chemical composition of groundwater is an important part of groundwater quality evaluation. Inorganic indicators of groundwater are direct parameters for evaluating groundwater quality. In particular, inorganic toxicological indicators such as fluoride, trinitrogen, and heavy metals have strict requirements in drinking water evaluation standards (Li CZ, et al., 2018; Ma HY, et al., 2018). "Comprehensive results of water quality analysis.xlsx" covers 119 samples in total and contains 37 data items of basic information, which are: unified No., field No., indoor No., testing code, water temperature, pH, K, Ca, Na, Mg, Sr, Ba, V, Fe, Ni, Zn, Ga, Sn, Ti, Bi, Al, Si, Cr, Cd, Sb, Ti, Mn, As, Be, B, Co, Cu, Li, Pb,

Table 5 Real Example of "Records of field water sampling.xlsx" in the Dataset

Field name	Real Example	Field name	Real Example
Unified No.	1101531501926491801	*EC*	394.9 μS/cm
Field No.	D1006	pH	4.67
Longitude	110153150	Color	Colorless
Latitude	19264918	Odor	Odorless
Coordinate X	19422160	Taste	Tasteless
Coordinate Y	2151354	Transparency	Transparent
Geographical location	Dachuan Village, Longmen Town, Qionghai City, Hainan Province	Chemical treatment means	Cation and concentrated nitric acid
Ground elevation	85 m	Sketch of planimetric location	(BLOB)
Map sheet No.	Longmen Map Sheet, No.: E49E004010	Remarks	
Sample No.	LM-FSH001	Project title	Environmental Geological Survey on a Scale of 1∶50 000 in the Economic Planning and Construction Zone of Southeast Hainan
Sampling date	September 18, 2017	Undertaken by	Wuhan Center, China Geological Survey
Sample type	Groundwater	Sampled by	Zhang Yanpeng
Previous sampling	No	Recorded by	Zhang Yanpeng
Static water level	10.69 m	Checked by	Yu Shaowen
Water temperature	26.43℃		

F, Cl^-, Br^-, NO_3^-, PO_4^{3-} and SO_4^{2}. See Table 6 for details. The units of the test results are mg/L).

3.3 Data of Boreholes

The data of boreholes in the Dataset mainly include two data tables in Excel, named "Basic information of boreholes.xlsx" (Table 7) and "Description of strata revealed by boreholes.xlsx" (Table 8).

3.4 Analysis of hydrochemical types

The groundwater collected is mainly pore fissure water in shallow bedrock weathering layer, and a small amount of bedrock fissure water. The groundwater hydrochemical characteristics are mainly affected and controlled by multiple factors such as atmospheric precipitation, rock and soil composition, and human activities, resulting in the complexity and diversity of groundwater hydrochemical types in the survey area. According to Shukarev classification, the main groundwater chemical types in the area are shown in Table 9.

As seen from Table 9, the shallow groundwater in the survey area is generally characterized by low salinity, with complex and diverse hydrochemical types. In terms of dividing groundwater types by anions, it mainly includes HCO_3-type, $HCO_3 \cdot SO_4$-type and Cl-type water, and is characterized by HCO_3-type and Cl-type water, which is close to 92% of all samples. In terms of dividing groundwater types by anions, the groundwater types are divided

Table 6 Real Example of "Comprehensive results of water quality analysis.xlsx" in the Dataset

Field name	Real Example	Field name	Real Example
Unified No.	1101531501926491801	Zn	0.06
Sample No.	LM-FSH001	Cd	0.00
Indoor No.	D1006	Mn	0.78
Testing code	FSH001	Ni	0.02
Water temperature	26.43	Co	0.02
pH	4.67	Total Cr	0.00
Be	0.00	V	0.00
K^+	33.04	Sr	0.05
Na^+	32.71	Sb	0.00
Ca^{2+}	5.73	Fe	0.01
Mg^{2+}	3.23	Tl	0.00
Cl^-	55.51	Ba	0.37
SO_4^{2-}	22.93	B	0.00
NO_3^-	44.90	Br^-	0.12
F^-	0.34	As	0.00
PO_4^{3-}	n.a.	Li	0.01
TDS	252.7	Al	0.36
Cu	0.00	Sampling date	Septemper 18, 2017
Pb	0.00		

Table 7 An Example of "Basic information of boreholes.xlsx" in the Dataset

Field name	Real Example	Field name	Real Example
Unified No.	1101609001925173301	Initial water level of aquifer	0.15 m
Field No.	LMSK01	Well depth	101.5 m
Longitude	110160900	Static water level	3.16 m
Latitude	19251733	Quality grade	Excellent
Coordinate X	19423242	Aquifer feature	Sandstone
Coordinate Y	2148525	Sketch of planimetric location	(BLOB)
Geographical location	Jiaotang Village, Longmen Town, Ding'an County, Hainan Province	Borehole histogram	(BLOB)
Ground elevation	91 m	Remarks	-
Map sheet No.	Longmen Map Sheet, No.: E49E004010	Project name	Environmental Geological Survey on a Scale of 1∶50 000 in the Economic Planning and Construction Zone of Southeast Hainan
Borehole head elevation	91 m	Constructed by	Hydrogeological Team from the Guangdong Geological Bureau of Nonferrous Metals
Drilling rig type	XY-1A-4	Date of survey	October 31, 2017
Borehole type	Hydrogeological drilling	Drilling foreman	Zheng Lianbing
Start date of drilling	October 31, 2017	Person in charge of geological logging	Chen Guorong
End date of drilling	November 18, 2017	Recorded by	Chen Guorong
Well deviation	0	Checked by	Yang Junshuo
Open hole diameter	168 mm	Filled on (date)	November 18, 2017
Final hole diameter	110 mm	Borehole ID	-
Final hole depth	101.5 m		

into Ca-type, Na·Ca-type, and Na-type, with Na·Ca-type and Na-type oriented, accounting for 75% of all samples. In general, the hydrochemical types of groundwater are mainly the Ca·Na-HCO_3-type and Na-Cl-type water.

The distributed hydrochemical type of the groundwater in the region shows that there is mainly HCO_3-Ca-type water in mountainous and hilly areas, and Cl-type water in the eroded plain area, which reveals a clear evolution law from mountainous to plain areas. Meanwhile, there is a certain correlation between the distribution of the groundwater types and the major villages and towns in the the survey area.

4 Data Quality Control and Assessment

4.1 Quality Control of Survey Points

The environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet

Table 8 An Example of "Description of strata revealed by boreholes.xlsx" in the Dataset

Field name	Example
Unified No.	1101609001925173301
Geological age	K
Stratum code	4
Index of site-based layer	–
Elevation of stratum bottom	84.5 m
Depth of stratum bottom	6.5 m
Thickness of a single layer	0.8 m
Contact relation at stratum bottom	–
Bedding structure	–
Name of rock or soil	Strongly weathered sandstone
Color of rock or soil	Lightly purplish-red in the upper part and grayish-yellow in the lower part
Stratigraphic geological description	Fine-grained and laminar structure, joints and fissures slightly developed, sedimentogenesis, composed of quartz and feldspar, cemented by clay, particle size: about 0.05–1 mm, signs of water erosion locally visible, water permeability: medium
Borehole ID	–

Table 9 Summary Table of the groundwater hydrochemical types in the survey area

Groundwater hydrochemical type	Number of samples	Percentage
Ca-HCO_3	5	
Na-HCO_3	6	50.00%
Ca·Na-HCO_3	15	
Ca·Na -HCO_3·SO_4	4	7.70%
Na·Ca-Cl	8	
Na-Cl	10	42.30%
Ca-Cl	4	

covers 405 various survey points, primarily including 221 pumping (domestic) well survey points and 77 comprehensive geological survey points in the field, accounting for 55% and 19% of the total survey point number respectively. In addition, there are 77 geological boundary points, 7 surface water survey points, 21 spring points and 3 geological structural survey points. Therefore, there are about 84 survey points per 100 km^2 on average, since the Longmen Map Sheet covers an area of about 480 km^2, reaching the survey point density in complex mountainous and hilly areas. The interval between routines is 1000−1200 m, compliant with the relevant requirements for medium complex areas. Pumping tests were carried out in 10 hydrogeological survey boreholes. Furthermore, there are 56 points where the water level will be simultaneously measured and 56 points from which water samples were taken for water-quality analysis; thereby meeting the quota requirement for water-quality analysis point number per 100 km^2 in complex mountainous and hilly areas specified in *Specification for Hydrogeological Survey* (1∶50 000) (DZ/T 0282-2015).

4.2 Quality Control of Collection and Testing of Water Samples

Water samples were taken and presented for tests in strict accordance with *Specifications for Geological Survey and Assessment of Groundwater Pollution* and the water samples were predominantly taken from hydrogeological survey points (such as pumping wells, domestic wells and wells in the water sources for concentrated water supply). A sampling plan was prepared before sampling and timely communication was made with labs undertaking the tests. At the same time, data tables of records and sampling labels were filled in a timely manner at each sampling site. All on-site testing indices were tested in the field and proper protective agents were added into the samples as required in the applicable specifications.

The samples were tested in qualified entities. As required by the environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet, technical parameters of all measuring methods met or exceeded the applicable standards.

4.3 Quality Control of Borehole Data

The boreholes were drilled in accordance with relevant technical specifications and the needs of the environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet. The stable state of the pumping tests was maintained for a period as required by related specifications and normal pumping curves were obtained. Therefore, various data obtained are true, credible and consistent with the actual conditions in the Longmen Map Sheet.

5 Conclusion

This Dataset contains the survey data, sampling information and analytical results of the water samples and borehole data obtained from the environmental geological survey on a scale of 1∶50 000 in the Longmen Map Sheet in 2017. All the work in the survey such as sampling, testing and drilling were conducted according to the relevant specifications. The data obtained are credible and can faithfully reflect the hydrogeological and environmental geological conditions in the Longmen Map Sheet. Moreover, based on this, a backup groundwater source was delineated and this will effectively alleviate the seasonal water shortage in the area.

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