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关中盆地地下水无机指标数据集 (2015 年度)

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摘要：本数据集包含了 2015 年在关中盆地采集的 200 个地下水样品的位置信息、取样层位信息及 33 项无机地球化学成分测试结果信息。水质综合评价的结果按照地下水质量级别划分，除去 10 个空白水样，样品中Ⅱ类水 2 件，Ⅲ类水 57 件，Ⅳ类水 56 件，Ⅴ类水 75 件；按照地下水水质类型划分，淡水 111 件，半咸水 71 件，咸水 8 件。采样过程规范，测试结果均由具备国家认可资质的实验室测试完成，数据质量可靠。关中盆地从盆地边缘至盆地中心，地下水化学类型由 HCO_3−Ca 型经 HCO_3−Ca·Mg·Na 型转变为 SO_4·Cl−Na 型，呈明显的水平分带性规律。水质评价的结果表明，该时段关中盆地地下水质量状况较差，有 68.9% 的地下水不适于直接饮用。其中Ⅱ−Ⅲ类水主要分布在关中盆地的南部、西部和北部的局部地区；Ⅳ类水主要分布在渭河边、高陵县、泾阳县和乾县；Ⅴ类水主要分布在大荔县、蒲城县、富平县、阎良区、咸阳市区周边、三原县和礼泉县。本数据集可为研究关中盆地地下水循环演化等提供地球化学指标参考。

关键词：水文地球化学；地下水水质分级；地下水循环演化；无机指标数据集；关中盆地

数据服务系统网址：http://dcc.cgs.gov.cn

1　引言

地下水的起源与分类是水文地质学基本理论课题之一；水文地球化学研究对这个课题的解决起着重大的促进作用（沈照理，1983）。水化学研究是刻画水循环及地下水补给关系的先进方法（杜虎林等，2008）。通过分析地下水的水化学特征，可揭示地下水的组成及来源，也是研究地下水循环和演化的重要手段（叶思源等，2002；杨郧城等，2008），该方法在国内外已有较广泛的应用。地下水的水文地球化学特征是受地下水循环演化过程控制的，它是地下水循环演化过程的信息库。由无机指标数据集绘制的地下水化学场可以与地下水流场、地下水温度场、地下水年龄等相互印证，共同用于研究地下水流系统的补给来源、径流途径、排泄方式等循环过程。多期的无机指标数据集可以指示地下水化学演化方向，确定地下水环境演化过程中的环境变化特征和规律，是水循

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环演化研究的重要依据（滕彦国，2010）。此外，地下水的化学组成也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。

此次调查工作由国家公益项目“鄂尔多斯盆地地下水污染调查评价”支持。“鄂尔多斯盆地地下水污染调查评价”工作区包括鄂尔多斯盆地和关中盆地两部分，其中“关中盆地地下水污染调查评价”为“鄂尔多斯盆地地下水污染调查评价”下属子项目，项目旨在查明鄂尔多斯盆地和关中盆地地下水质量现状，研究水环境污染程度。项目组对采样过程、送样过程、测试环节质量进行严格把关。测试项包括了地下水和部分地表水无机指标和微量有机指标。本文针对其中可公开发布的无机测试结果进行整理，把数据较齐全的地下水样品的测试数据集进行发布，可为研究关中盆地地下水循环演化等提供数据支撑。关中盆地地下水无机指标数据集元数据见表 1。

表 1　数据库（集）元数据简表

条目	描述
数据库（集）名称	关中盆地地下水无机指标数据集（2015年度）
数据库（集）作者	李成柱，中国地质调查局干旱半干旱区地下水与生态重点实验室，中国地质调查局西安地质调查中心 马洪云，中国地质调查局干旱半干旱区地下水与生态重点实验室，中国地质调查局西安地质调查中心 吴耀国，西北工业大学
数据时间范围	2015年
地理区域	关中盆地，东经106°50′~110°50′，北纬33°50′~35°50′
数据格式	*.xls
数据量	8.26 MB
数据服务系统网址	http://dcc.cgs.gov.cn
基金项目	国家公益项目“鄂尔多斯盆地地下水污染调查评价”（12120114056201）
语种	中文
数据库（集）组成	本数据集包含200个地下水样品的测试数据，包含如下测试指标：样品点编号、野外样品编号、经度、纬度、地理位置（详细到村）、水点类型、采样层位、样品性质、地下水质量分级、水质类型、电导率（EC）、总硬度、永久硬度、暂时硬度、总碱度、溶解性总固体、pH值、Ca^{2+}、Mg^{2+}、K^{+}、Na^{+}、Cl^{-}、SO_4^{2-}、HCO_3^{-}、CO_3^{2-}、NO_3^{-}、NO_2^{-}、NH_4^{+}、F^{-}、PO_4^{3-}、H_2SiO_3、Cu、Mn、Zn、Hg、Cr^{6+}、As、Pb、Cd、Al、I^{-}、总矿化度、Fe、取样日期

2　数据采集和处理方法

本次共采集测试地下水无机项样品 200 个，其中包括空白样 10 件，重复样 9 组。采样点基本覆盖了整个关中盆地，采样水体以潜水为主，取样层位为当地常用水井的主要开采层位。采样点分布见图 1。

采样点位置信息采用手持 GPS 进行定位，地图参数是以 1980 年西安坐标系为参照系，记录经纬度坐标及地名等地理位置信息。样品测试采用现场测试和室内测试相结合，野外现场测试采用 LOVIBOND 多参数测定仪（SD150D）对 pH 值、电导率等进行现场测试。同时，采集 2 瓶 500 mL 水样，采样瓶选用聚乙烯塑料瓶，密封送实验室用于室内测试。所有采集地下水样品均送往具备国家认可资质的实验室进行测试分析，并出具测试分析报告。水质综合评价的结果按照地下水质量级别划分，除去 10 个空白水

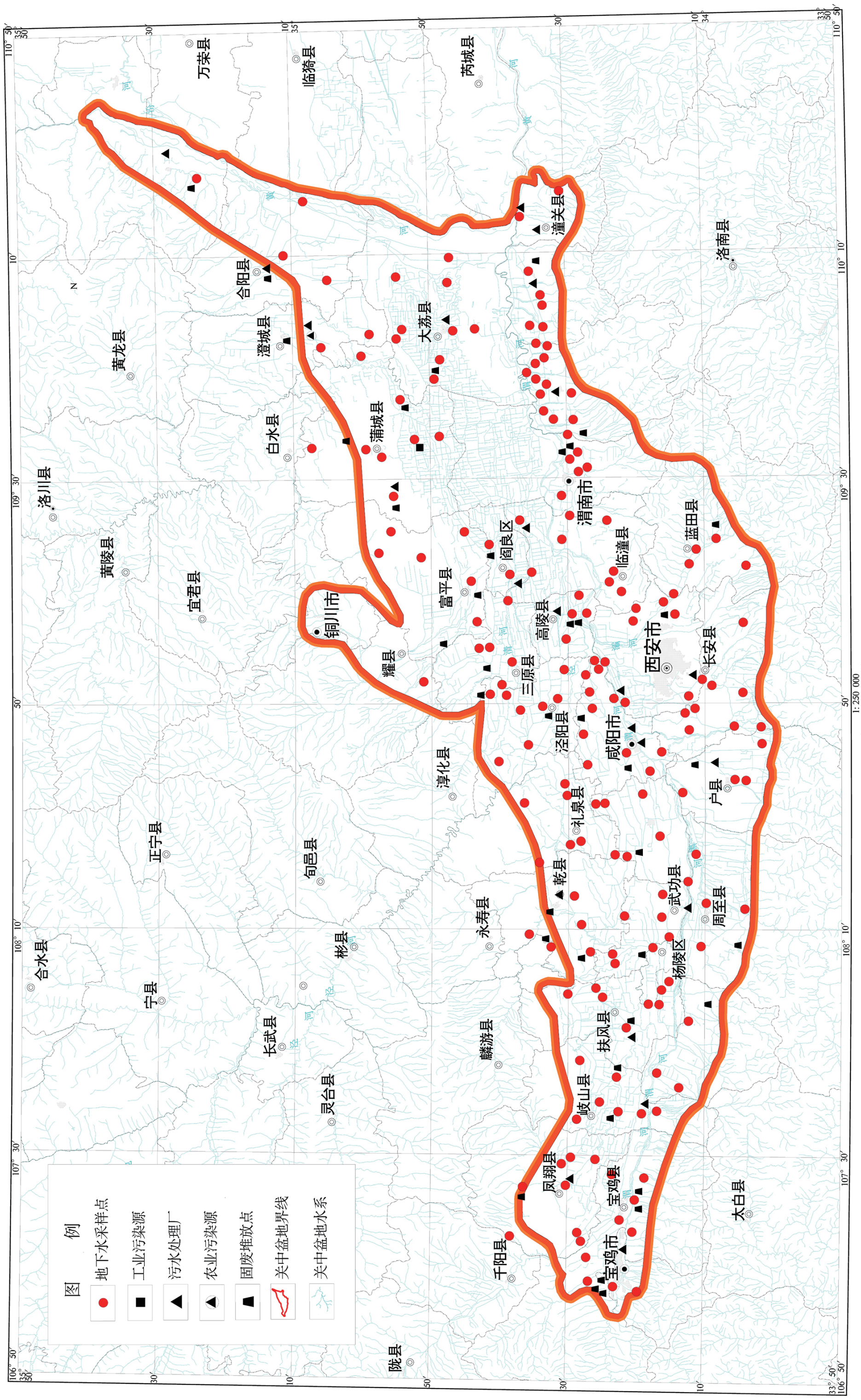

图 1　关中盆地地下水采样点分布图

样，样品中Ⅱ类水 2 件，Ⅲ类水 57 件，Ⅳ类水 56 件，Ⅴ类水 75 件（表 2）；按照地下水水质类型划分，淡水 111 件，半咸水 71 件，咸水 8 件（表 3）。

表 2　关中盆地地下水水质评价统计表（不含空白样）

地下水质量分级	Ⅱ	Ⅲ	Ⅳ	Ⅴ
样品数量（件）	2	57	56	75

表 3　关中盆地地下水矿化度统计表（不含空白样）

地下水水质类型	淡水	半咸水	咸水
样品数量（件）	111	71	8

3　数据样本描述

地下水无机数据按照统一格式汇总于 Excel 表格中，每个表行显示一个样品的相关数据，每个样品均包括如下内容（表 4）：样品点编号、野外样品编号、经度、纬度、地理位置（详细到村）、水点类型、采样层位、样品性质、地下水质量分级、水质类型、电导率（EC）、总硬度、永久硬度、暂时硬度、总碱度、溶解性总固体、pH 值、Ca^{2+}、Mg^{2+}、K^{+}、Na^{+}、Cl^{-}、SO_4^{2-}、HCO_3^{-}、CO_3^{2-}、NO_3^{-}、NO_2^{-}、NH_4^{+}、F^{-}、PO_4^{3-}、H_2SiO_3、Cu、Mn、Zn、Hg、Cr^{6+}、As、Pb、Cd、Al、I^{-}、总矿化度、Fe、取样日期。

表 4　关中盆地地下水无机指标数据集测试指标示例表

序号	字段名称	量纲	实例
1	样品点编号	–	10706496342306900
2	样品野外编号	–	BJ01
3	经度	DDDMMSS.S	10706496
4	纬度	DDMMSS.S	3427545
5	地理位置	–	陕西省宝鸡市凤翔县长青镇马道口村
6	水点类型	–	井
7	采样层位	–	潜水
8	样品性质	–	地下水
9	电导率（EC）	μs/cm	633
10	总硬度	mg/L	239
11	永久硬度	mg/L	0
12	暂时硬度	mg/L	239
13	总碱度	mg/L	316
14	溶解性总固体	mg/L	384
15	pH值	mg/L	8.05
16	Ca^{2+}	mg/L	91.20
17	Mg^{2+}	mg/L	31.40
18	K^{+}	mg/L	5.73
19	Na^{+}	mg/L	61.00
20	Cl^{-}	mg/L	71.50
21	SO_4^{2-}	mg/L	63.50
22	HCO_3^{-}	mg/L	436.00
23	CO_3^{2-}	mg/L	0.00

续表 4

序号	字段名称	量纲	实例
24	NO_3^-	mg/L	4.80
25	NO_2^-	mg/L	<0.01
26	NH_4^+	mg/L	0.04
27	F^-	mg/L	0.49
28	PO_4^{3-}	mg/L	<0.01
29	H_2SiO_3	mg/L	21.70
30	Cu^{2+}	mg/L	0.003
31	Mn	mg/L	<0.001
32	Zn	mg/L	0.015
33	Hg	μg/L	<0.000 05
34	Cr^{6+}	mg/L	0.012
35	As	mg/L	<0.001
36	Pb	mg/L	<0.001
37	Cd	mg/L	<0.001
38	Al	mg/L	0.004
39	I^-	mg/L	<0.05
40	总矿化度	mg/L	510
41	Fe	mg/L	0.066
43	取样日期	年-月-日	2015-7-22

4　数据质量控制和评估

4.1　样品采集

样品采集和送检工作严格按照《区域地下水污染调查评价规范》(DZT0288–2015)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；样品采集现场及时填写了记录表和采样标签；部分样品还按要求完成现场测试和记录；样品按规范要求加相应的保护剂（汪珊，2004；张春潮，2013；马洪云等，2018；侯建军，2018）。

地下水水化学成分的无机检测项比较稳定，光、热、震动等的变化对其影响甚微；因此，对取样过程、运输过程等环节没有特别的要求，主要是做到密闭，避免污染和泄露。采样作业中重点确保每个样品的代表性和真实性，使得每个样品尽可能准确的反映一个地区地下水环境质量（孙继朝，2015）。

4.2　数据质量

所采水样均由西安地质矿产研究所实验测试中心承担。根据项目的要求，所有分析方法均采用了《地质矿产实验室测试质量管理规范》(DZ/T 0130.6–2006）和其他相关的国家和行业的标准，各项技术参数均达到或优于相应标准以及本项目的要求。测试选择的分析方法的检出限也均达到或优于规范的要求。

每一批次试样随机抽取 20% 的重复分析，编成密码，重复分析相对偏差允许限为：

$$Y = 11.0 \cdot C \cdot X^{-0.28} \tag{1}$$

其中，Y 为允许限，X 为各组分析结果的浓度（mg/L），C 为不同分析项目的系数，测试结果的偏差允许限均小于 3%。

测试中心对所采集的全部地下水样品进行了阴、阳离子总量平衡与可溶性固体总量平衡的检验，结果合格率达到规范的要求。

4.3 质量总体评估

所有水质分析样品的采集均严格按照有关要求执行。样品的测试由具有国家测试资质的中国地质调查局西安地质矿产研究所实验测试中心完成，所测定的无机检测项目包括电导率（EC）、总硬度、永久硬度、暂时硬度、总碱度、溶解性总固体、pH 值、Ca^{2+}、Mg^{2+}、K^{+}、Na^{+}、Cl^{-}、SO_4^{2-}、HCO_3^{-}、CO_3^{2-}、NO_3^{-}、NO_2^{-}、NH_4^{+}、F^{-}、PO_4^{3-}、H_2SiO_3、Cu、Mn、Zn、Hg、Cr^{6+}、As、Pb、Cd、Al、I^{-}、总矿化度、Fe 共 33 种元素（或项目）的分析测试工作，分析测试结果真实，可靠，符合质量要求。

5 结论

本数据集包含了 2015 年在关中盆地采集的 200 个地下水样品的位置信息、取样层位信息，以及 33 项无机地球化学指标测试结果信息。得出以下几点结论：

（1）关中盆地地下水动力场对水化学场起着控制性作用：从盆地边缘至盆地中心，地下水流速由快变慢，水流交替条件由强变弱，水化学演化作用则从溶滤作用变为蒸发浓缩作用为主，水化学类型由 HCO_3−Ca 型经 HCO_3−Ca·Mg·Na 型转变为 SO_4·Cl−Na 型，呈明显的水平分带性规律；而人类活动的影响则使得水化学的形成与演化更加复杂，这些因素共同作用，影响着关中盆地潜水的水文地球化学的分布特征及其变化规律。

（2）影响关中盆地地下水质量的指标主要有：无机常规指标 Fe、Mn、Mg^{2+}、Na^{+}、Cl^{-}、SO_4^{2-}、TH、TDS、高锰酸钾指数；无机毒理性指标 Cr^{6+}、F^{-}、NO_2^{-}、NO_3^{-}、碘化物。

（3）超出Ⅲ类水标准的有 131 组，即有 68.9% 的水不适于直接饮用。

（4）Ⅴ类水主要分布在大荔县、蒲城县、富平县、阎良区、咸阳市区周边、三原县和礼泉县；Ⅳ类水主要分布在渭河边、高陵县、泾阳县和乾县；Ⅱ−Ⅲ类水主要分布在关中盆地的南部、西部和北部的局部地区。

致谢：感谢中国地质调查局西安地质矿产研究所实验测试中心在规范化采样方面给出的宝贵建议及对样品密闭措施的精心核查。

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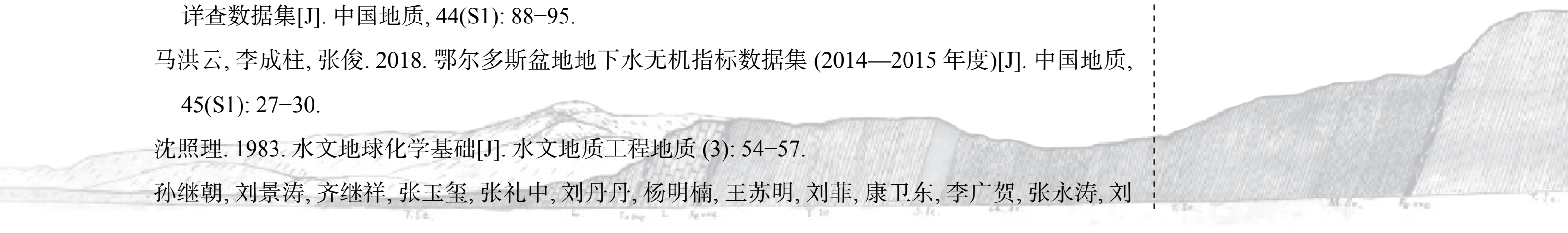

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An Inorganic Index Dataset of Groundwater in the Guanzhong Basin (2015)

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Abstract: This dataset contains information about the locations and sampling layers of 200 groundwater samples taken in the Guanzhong Basin in 2015 as well as test results of 33 inorganic geochemical components. According to a comprehensive water quality evaluation, the samples above, if classified by water quality level, include 10 blank samples, 2 class−II samples, 57 class−III samples, 56 class−IV samples, and 75 class−V samples. If classified by water quality type, they include 111 fresh water samples, 71 brackish water samples, and 8 saline water samples. Samples were taken in compliance with procedures. Test results were obtained in qualified laboratory tests, so the obtained data was of a reliable quality. From the margin to the center of the Guanzhong Basin, the hydrochemical types of groundwater change from HCO_3–Ca to HCO_3−Ca·Mg·Na and then to SO_4·Cl−Na, presenting a distinct horizontal zoning character pattern. According to the water quality evaluation, the groundwater quality is poor in Guanzhong Basin at this time, with 68.9% of the groundwater unfit for drinking. Class II and III water is mainly distributed in some areas to the south, west, and north of the Guanzhong Basin. Class IV water is mainly distributed around the Weihe River, and in Gaoling County, Jingyang County, and Qian County. Class V water is mainly distributed throughout the counties of Dali, Pucheng, Fuping, Sanyuan and Liquan, Yanliang District and surrounding areas of Xianyang City. This dataset will provide a geochemical indicator reference for studying the cyclical evolution of groundwater in the Guanzhong Basin.

Key words: hydrogeochemistry; groundwater quality leveling; groundwater cyclic evolution; inorganic index dataset; Guanzhong Basin

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

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1 Introduction

The origin and classification of groundwater is a basic theoretical subject of hydrogeology; and the hydrogeochemical study plays a driving role in addressing this issue (Shen ZL, 1983). Hydrochemistry is an advanced means to describe the relationship between hydrological cycles and groundwater supply (Du HL et al., 2008). Analyzing the hydrochemistry of groundwater reveals the composition and origin of groundwater and is a significant approach to studying groundwater cycles and evolution (Ye SY et al., 2002; Yang YC et al., 2008); this approach has been widely applied at home and abroad. The hydrogeochemistry of groundwater is controlled by, and provides information for, groundwater cyclical evolution. With an inorganic index dataset, a groundwater chemical field can be plotted to cross-validate the flow field, temperature field, and the age of the groundwater, etc., and these fields are used to study the cycles of the groundwater system, such as supply source, runoff path, and discharge mode of groundwater. Inorganic index datasets of multiple stages can show the chemical evolution direction of groundwater, determine the characteristics and rules of environmental changes in the environmental evolution of groundwater, and function as an important reference for the study of hydrological cycle evolution (Teng YG, 2010). In addition, the chemical composition and inorganic indices of groundwater are important content and direct parameters, respectively, for the evaluation of groundwater quality. Among the indicators, such inorganic toxicological indicators as fluoride ions, ammonia ions, nitrate ions, nitrite ions, and heavy metal, must be in compliance with strict standards for evaluating drinking water.

This survey is supported by the National Public Welfare Project “Investigation and Evaluation of Groundwater Contamination of the Ordos Basin”. The project area includes the Ordos Basin and the Guanzhong Basin, of which “Investigation and Evaluation of Groundwater Contamination of the Guanzhong Basin” is a subproject; the project aims at investigating the groundwater quality of the Ordos Basin and the Guanzhong Basin and studying the hydrological contamination. The project team strictly controlled the processes for taking, delivering and testing samples. Groundwater and some surface water samples were tested for inorganic indices and microorganic indicators. For this paper, the inorganic test results were processed that were allowed for open release, and the relatively complete test datasets of groundwater samples were released, which can provide data support for studying the groundwater cyclical evolution of the Guanzhong Basin. Table 1 lists the metadata of the inorganic index dataset of groundwater in the Guanzhong Basin.

Table 1 Metadata Table of Database (Dataset)

Items	Description
Database (dataset) name	An Inorganic Index Dataset of Groundwater in the Guanzhong Basin (2015)
Database (dataset) authors	Li Chengzhu, Key Laboratory for Groundwater and Ecology in Arid and Semi−Arid Areas, China Geological Survey; Xi'an Center, China Geological Survey; Ma Hongyun, Key Laboratory for Groundwater and Ecology in Arid and Semi−Arid Areas, China Geological Survey; Xi'an Center, China Geological Survey Wu Yaoguo, Northwestern Polytechnical University

Continued table 1

Items	Description
Data acquisition time	2015
Geographical area	Guanzhong Basin at 106°50′~110°50′E and 33°50′~35°50′N
Data format	*.xls
Data size	8.26 MB
Data service system URL	http://dcc.cgs.gov.cn
Funded project	National Public Welfare Project entitled “Investigation and Evaluation of Groundwater Contamination of the Ordos Basin” (12120114056201)
Language	Chinese
Database (dataset) composition	This dataset contains the test data from 200 groundwater samples, including the following test indicators: sampling point number, field sample number, longitude, latitude, geographical location (village), water point type, sampling layer, sample attribute, groundwater quality level, water quality type, electrical conductivity (EC), total hardness , permanent hardness , temporary hardness , total alkalinity, total dissolved solids, pH value, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, Cl^{-}, SO_4^{2-}, HCO^{3-}, CO_3^{2-}, NO_3^{-}, NO_2^{-}, NH_4^{+}, F^{-}, PO_4^{-}, H_2SiO_3, Cu, Mn, Zn, Hg, Cr^{6+}, As, Pb, Cd, Al, I^{-}, total mineralization, Fe, and sampling date.

2 Data Acquisition and Processing

200 groundwater samples were taken and tested for inorganic indices. Among the samples, 10 were blank samples and 9 were replicate samples. All samples were taken at major development layers of local water wells all across the Guanzhong Basin and the majority of the samples were phreatic water. Fig. 1 shows the distribution of sampling points.

The location information of the sampling points was obtained using handheld GPS devices and the 1980 Xi’ an coordinate system as a map reference. Geographical location information, such as the coordinates of latitude and longitude and location names, was recorded. Samples were tested in both field and laboratory. In field tests, a Lovibond multi−parameter tester (SD150D) was used to test pH values and electrical conductivity. In addition, two 500 ml water samples were collected and sealed in polyethylene plastic bottles and then sent for laboratory tests to labs certified by national certification authorities. Each test was issued with a test and analysis report. According to the results of comprehensive water quality evaluations, groundwater samples if classified by water quality level include 10 blank samples, 2 class−II samples, 57 class−III samples, 56 class−IV samples, and 75 class−V samples, as shown in Table 2. If classified by water quality type, the groundwater samples include 111 fresh water samples, 71 brackish water samples, and 8 saline water samples, as shown in Table 3.

3 Data Sample Description

All inorganic data derived from the groundwater samples were listed in a unified format in an Excel file. Each sheet in the file provided the data of a sample, covering the following items as shown in Table 4: sampling point number, field sample number, longitude, latitude, geographical location (village), water point type, sampling layer, sample attribute, groundwater

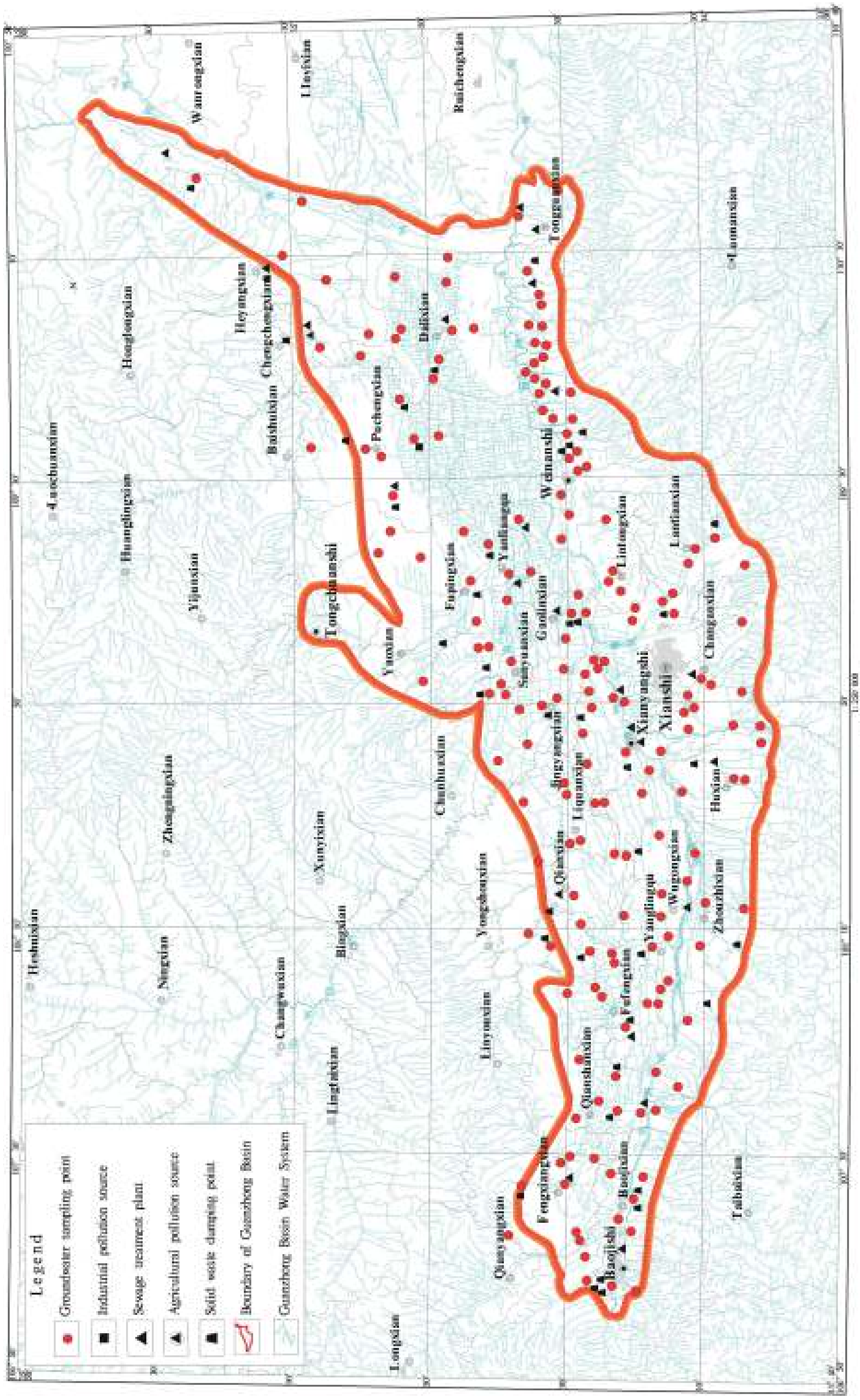

Fig. 1 Distribution of Groundwater Sampling Points in the Guanzhong Basin

quality level, water quality type, electrical conductivity (EC), total hardness, permanent hardness, temporary hardness, total alkalinity, total dissolved solids, pH value, Ca^{2+}, Mg^{2+}, K^+, Na^+, Cl^-, SO_4^{2-}, HCO^{3-}, CO_3^{2-}, NO_3^-, NO_2^-, NH_4^+, F^-, PO_4^-, H_2SiO_3, Cu, Mn, Zn, Hg, Cr^{6+}, As, Pb, Cd, Al, I^-, total mineralization, Fe, and sampling date.

Table 2 Quality Evaluation Statistics of Groundwater in the Guanzhong Basin (excluding blank samples)

Groundwater Quality Level	II	III	IV	V
Number of samples	2	57	56	75

Table 3 Salinity Statistics of Groundwater in the Guanzhong Basin (excluding blank samples)

Groundwater Quality Type	Fresh Water	Brackish Water	Saline water
Number of samples	111	71	8

Table 4 Test Indicator Samples of the Inorganic Index Dataset of Groundwater of Guanzhong Basin

Serial number	Field name	Dimension	Real example
1	Sampling point number	−	10706496342306900
2	Field sample number	−	BJ01
3	Longitude	DDDMMSS.S	10706496
4	Latitude	DDMMSS.S	3427545
5	Geographical location	−	Madaokou Village, Changqing Town, Fengxiang County, Baoji City, Shaanxi Province
6	Water point type	−	Well
7	Sampling layer	−	Phreatic water
8	Sample attribute	−	Groundwater
9	EC	μs/cm	633
10	total hardness	mg/L	239
11	Permanent hardness	mg/L	0
12	Temporary hardness	mg/L	239
13	Total alkalinity	mg/L	316
14	Total dissolved solids	mg/L	384
15	pH value	mg/L	8.05
16	Ca^{2+}	mg/L	91.20
17	Mg^{2+}	mg/L	31.40
18	K^+	mg/L	5.73
19	Na^+	mg/L	61.00
20	Cl^-	mg/L	71.50
21	SO_4^{2-}	mg/L	63.50
22	HCO_3^-	mg/L	436.00
23	CO_3^{2-}	mg/L	0.00
24	NO_3^-	mg/L	4.80

Continued table 4

Serial number	Field name	Dimension	Real example
25	NO_2^-	mg/L	<0.01
26	NH_4^+	mg/L	0.04
27	F^-	mg/L	0.49
28	PO_4^-	mg/L	<0.01
29	H_2SiO_3	mg/L	21.70
30	Cu	mg/L	0.003
31	Mn	mg/L	<0.001
32	Zn	mg/L	0.015
33	Hg	μg/L	<0.000 05
34	Cr^{6+}	mg/L	0.012
35	As	mg/L	<0.001
36	Pb	mg/L	<0.001
37	Cd	mg/L	<0.001
38	Al	mg/L	0.004
39	I^-	mg/L	<0.05
40	Total mineralization	mg/L	510
41	Fe	mg/L	0.066
43	Sampling date	YYYY−MM−DD	2015−7−22

4 Data Quality Control and Evaluation

4.1 Sample Collection

Samples were collected and delivered strictly as required by the *Specification for Regional Groundwater Contamination Investigation and Evaluation* (DZT0288-2015). The majority of the sampling points were distributed at the hydrogeological survey points, such as motor-pumped wells, domestic wells, and water source wells for a centralized supply of water. Prior to each sampling operation, a sampling plan was in place and detailed to the participating lab. In the sampling field, sampling log sheets were filled and samples were labeled. Some samples were also field tested and recorded. Proper protection agents were applied to samples as required (Wang S, 2004; Zhang CC, 2013; Ma HY et al., 2018; Hou JJ, 2017).

Items for inorganic tests of groundwater hydrochemical compositions are stable and are only slightly affected by the variation of light, heat, and vibration. Therefore, there are no special requirements for the sampling and transportation processes, as long as a good seal can be ensured to prevent contamination and leakage. In sampling operations, all samples must be representative and real, and able to reflect the quality of groundwater in the entire region (Sun JC, 2015).

4.2 Data Quality

All water samples were tested by the Experiment and Test Center, Xi'an Center, China Geological Survey. According to the project requirements, all analytical methods complied with the *Specification of Testing Quality Management for Geological Laboratories* (DZ/T

0130.6-2006) and other related national and industrial standards, and all technical parameters met or exceeded the requirements of related standards and this project or exceeded expectations. Detection limits of the analytical methods for testing also met the requirements of specifications or exceeded expectations.

20% of the samples in each batch were randomly selected for repeated analysis and compiled into code. The allowable limit of relative deviation in the repeated analysis is as follows:

$$Y = 11.0 \cdot C \cdot X^{-0.28} \tag{1}$$

where: Y is the allowable limit, X is concentration of each component in mg/l, and C is the coefficient of each analysis item. The allowable limit of the test outcome bias is lower than 3%.

The Test Center tested the aggregate balance between anions and cations and the stability of the aggregate soluble solids. The pass rate of the test results met the requirements.

4.3 Overall Quality Evaluation

All water samples for quality analysis were collected in compliance with related requirements and tested by the Experiment and Test Center, Xi'an Center, China Geological Survey, with a national testing qualification. The following 33 elements (or items) were analyzed for the inorganic test: electrical conductivity (EC), total hardness, permanent hardness, temporary hardness, total alkalinity, total dissolved solids, pH value, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, Cl^{-}, SO_4^{2-}, HCO^{3-}, CO_3^{2-}, NO_3^{-}, NO_2^{-}, NH_4^{+}, F^{-}, PO_4^{-}, H_2SiO_3, Cu, Mn, Zn, Hg, Cr^{6+}, As, Pb, Cd, Al, I^{-}, total mineralization, and Fe, and the analytical results were real and reliable and met quality requirements.

5 Conclusions

This dataset contains information about the locations and sampling layers of 200 groundwater samples taken in the Guanzhong Basin in 2015 as well as test results of 33 inorganic geochemical indicators. The conclusions are as follows:

(1) In the Guanzhong Basin, the dynamic field of groundwater controls the hydrochemical field: from the margin to the center of the basin, groundwater flow velocity changes from fast to slow and the water flow alteration condition changes from strong to weak, while the hydrochemical evolution changes from lixiviation to evaporation and concentration and hydrochemical types change from $HCO_3{-}Ca$ to $HCO_3{-}Ca{\cdot}Mg{\cdot}Na$ and then to $SO_4{\cdot}Cl{-}Na$, presenting a distinct horizontal zoning character pattern. However, human activities make the formation and evolution of the hydrochemistry more complicated. These factors work together to affect the hydrogeochemical distribution characteristics and change the rules for phreatic water in the Guanzhong Basin.

(2) The following major indicators affect the groundwater quality in the Guanzhong Basin: inorganic regular indicators including Fe, Mn, Mg^{2+}, Na^{+}, Cl^{-}, SO_4^{2-}, TH, TDS and $KMnO_4$; and inorganic toxicological indicators including Cr^{6+}, F^{-}, NO_2^{-}, NO_3^{-}, and iodide.

(3) The quality levels of 131 samples are higher than class III. It means that 68.9% of the groundwater is unfit for drinking.

(4) Class V water is mainly distributed in the counties of Dali, Pucheng, Fuping, Sanyuan and Liquan, Yanliang District and surrounding areas of Xianyang City. Class IV water is mainly distributed along the Weihe River, and in Gaoling County, Jingyang County and Qian County. Class II and III water is mainly distributed in some areas to the south, west, and north of the Guanzhong Basin.

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