The Level of Soil Gas Radon in a High Radiation Background City in CHINA

10th INTERNATIONAL WORKSHOP on the
GEOLOGICAL ASPECTS OF RADON RISK MAPPING
September 22nd – 25th, 2010 Prague, Czech Republic

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Background

- **Radon potential mapping have carried out since 1980s, but China hasn't conducted any research in this area yet.**
- **Two research projects have carried out**
  China Geological Survey(CSG)
  National Natural Sciences Foundation of China (NSFC)
  2002-2003.

objective

1.Study on the methods of dose rate estimation based on airborne gamma-ray spectrometry

2.Study on the method of environment radon assessment

Study area- Zhuhai City

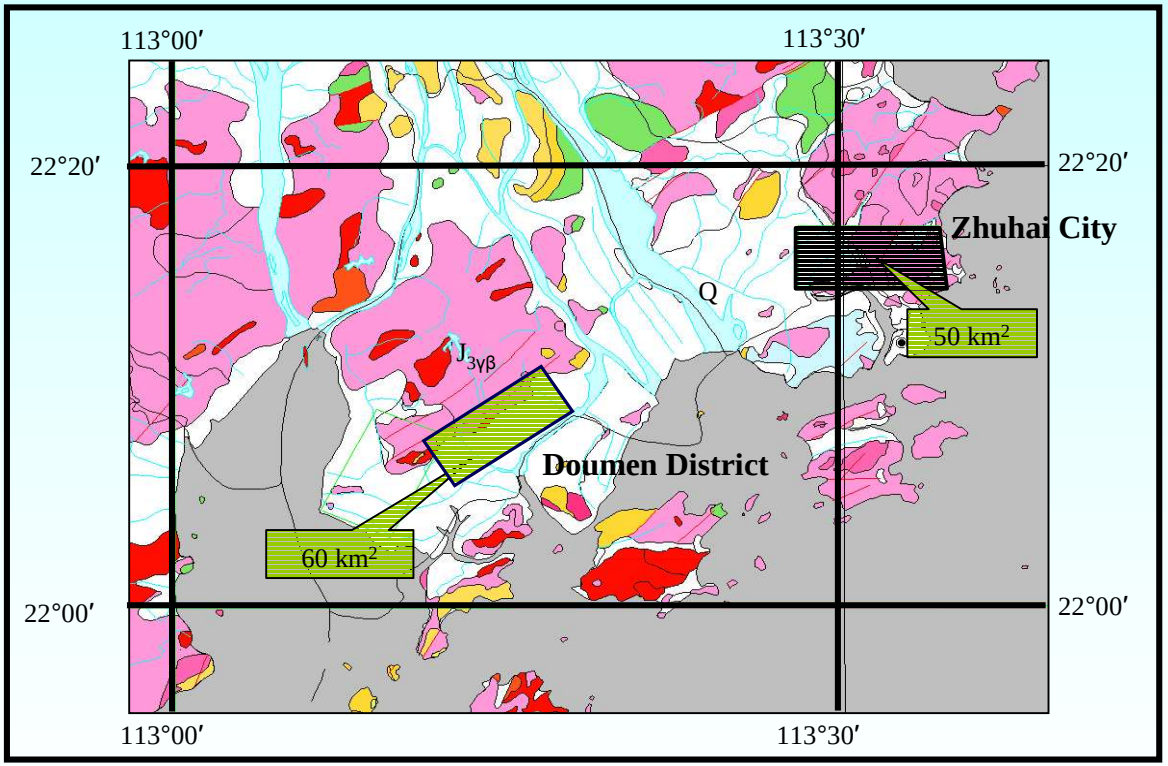
in population-intensive and high radon potential areas

Overview of investigation area

- **Geological setting is simple.**

  Late Jurassic biotitic-granite and granodiorite; Quaternary sediments
- **Geography: monadnock with height from dozens of meters to several hectometers.**
- **Climate: subtropical**

Geological Map of Investigation Area



Instrument and method for soil radon

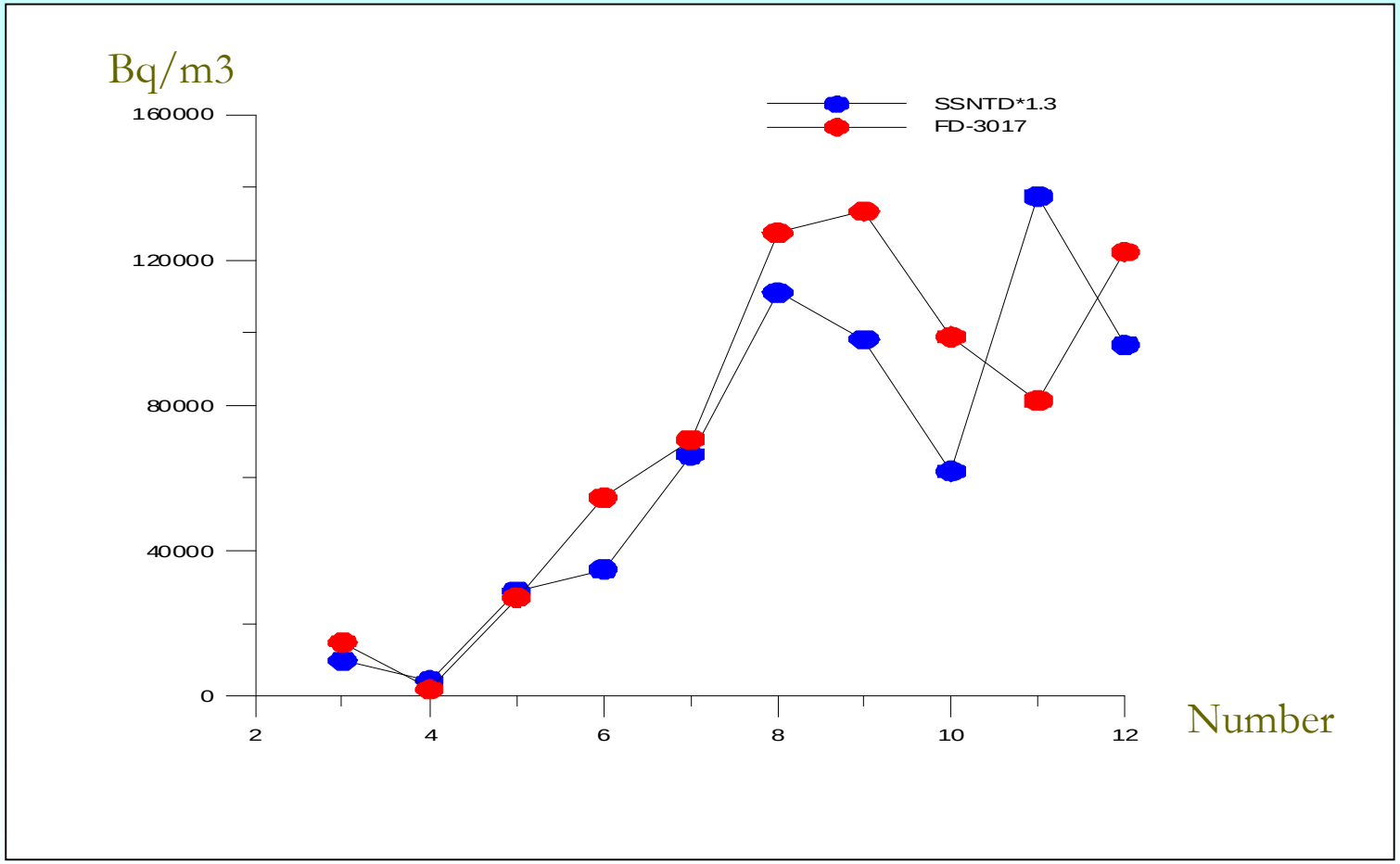
- Radon monitor-FD-3017, made in China
- The system consists of a radon gas probe, a manual sampling pump (also using as radon decay chamber) and an alpha-spectroscopy with surface barrier detector

FD-3017 Calibration and Test

Relative humidity(% RH)	Radon concentration(kBqm^{-3})		Relative Error (B-A)/A*100%
	A (PQ2000)	B (FD-3017)	
30	35.4	37.4	5.66
40	5.7	5.6	-1.75
50	28.5	23.4	-17.89
60	4.6	5.2	13.04
80	6.5	6.9	6.15
100	16.0	16.9	5.62

Influence of humidity on collecting efficiency for ^{218}Po

Comparison of FD-3017 and CR-39



Instantaneous and short term radon concentration measurement comparing (Tracking method and FD-3017)

Measurements in the field

- γdose rate measurement-sintilation detecor
- soil radon concentration measurement-grab
- indoor radon measurements- CR-39
- Soil radon exhalation rate- charcoal

Location and depth

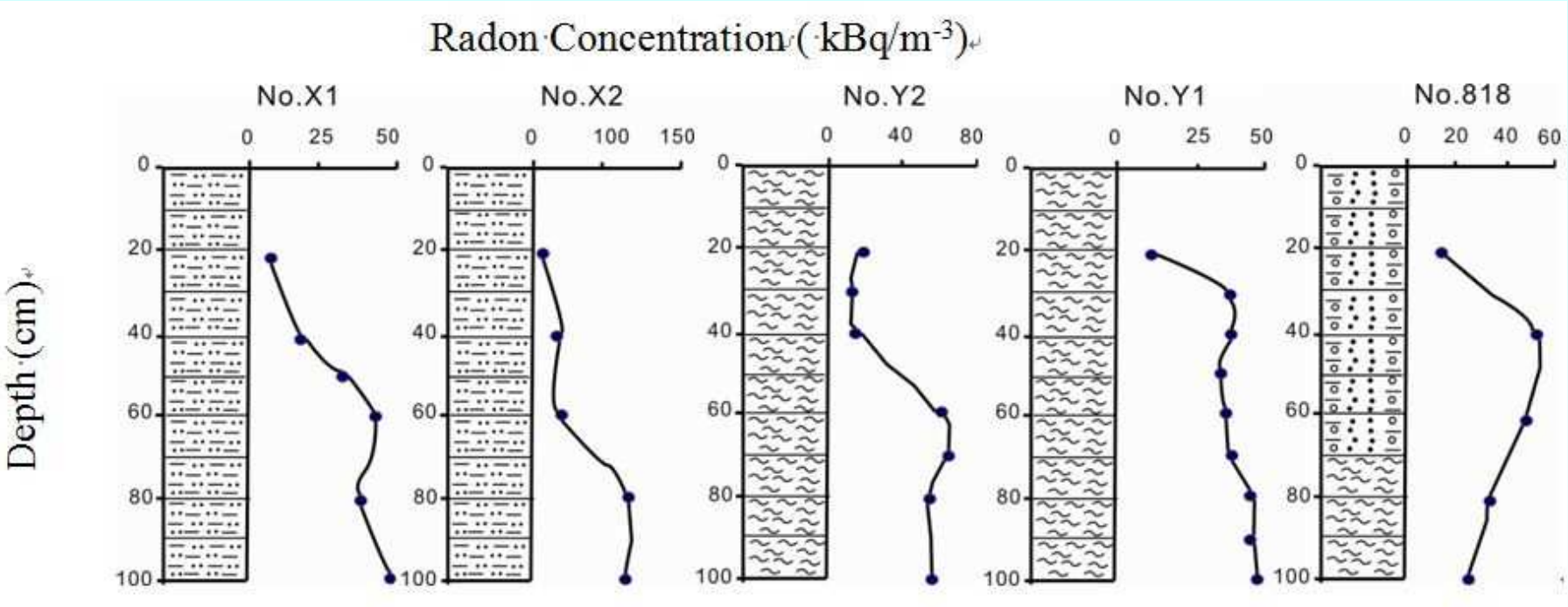
- Located with a portable GPS, ±15m
- Line distance: 2000m, site interval 50-150m, in Doumen distrct
- in different site intervals in Zhuhai City

- Depth:0.6m, volume: 1.5l

The level of soil radon

- **Various Mode of Soil Gas Radon with Depth**
- **Uniformity of Soil Gas Radon Distribution**
- **Soil Gas Radon Concentration and Lithology**
- **Statistics**
- **Comparison of Zhuhai and other city**
- **Indoor radon and soil radon prospecting**

Variation of measured radon concentration with depth in ZUA



Uniformity of Soil Gas Radon Distributio

Test mode	Location	The average ($kBqm^{-3}$)	Standard deviation	*Number* number of probes	The distance between measured probe and the central probe (m)
Multi-sampling	131	19.76	3.88	5	1.5
	132	27.06	3.47	2	1.7
	133	6.33	0.20	2	2.0
	140	30.86	4.07	2	1.5
	141	47.85	0.13	2	1.5
	151	32.39	3.58	3	2
	300-2	29.96	14.31	5	2
	312-2	46.79	58.92	5	2
	134	98.18	49.52	2	2
	138	39.99	46.09	3	2.5
	148	33.33	13.36	3	1.7
Repeated sampling	135	34.59	2.47	1	Extracting soil gas two times
	136	214.70	13.43	1	Extracting soil gas three times
	137	34.48	2.29	1	Extracting soil gas three times
	139	12.73	1.67	1	Extracting soil gas two times
	142	73.95	1.81	1	Extracting soil gas four times
	144-1	75.45	6.40	1	Extracting soil gas two times
	144-2	192.09	4.40	1	Extracting soil gas two times

Uniformity of Soil Gas Radon Distribution

1. Multi-sampling:

most of sites are relatively homogeneous within 1.5 m - 2.5 m, in Zhuhai City

But not in Doumen District

2. Repeated sampling:

soil gas was relatively stable

Soil Gas Radon Concentration and Lithology correction

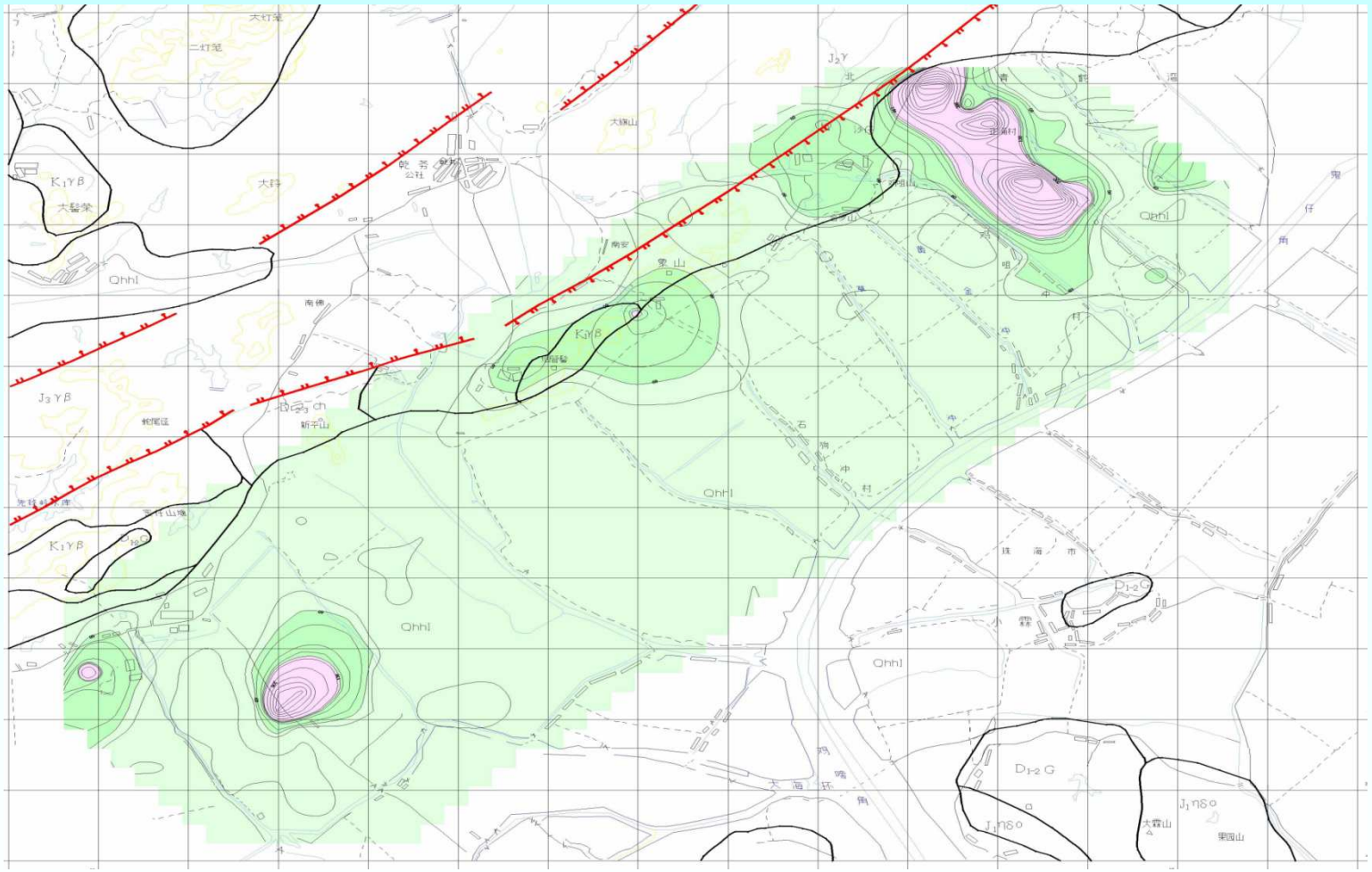
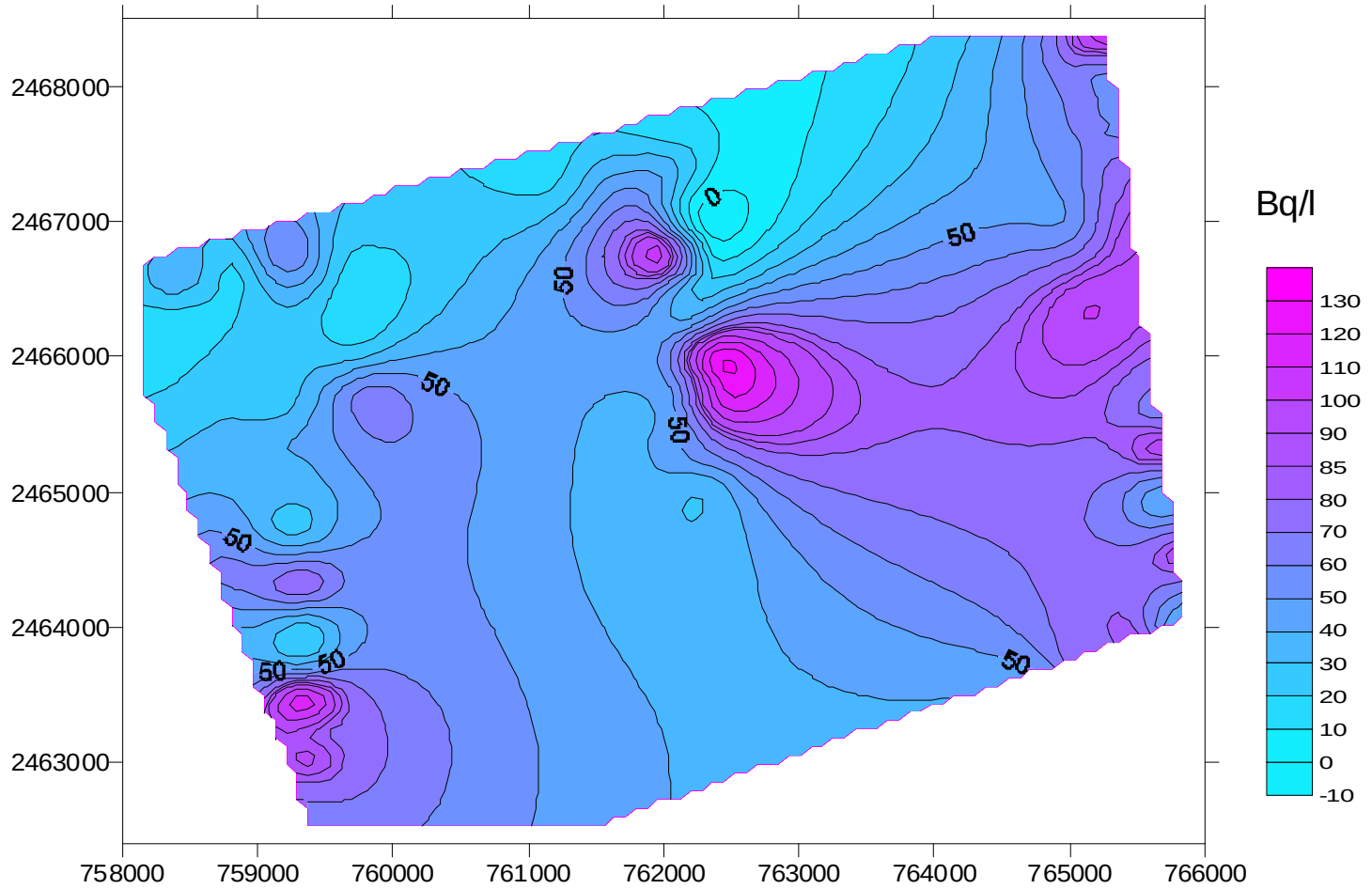


Fig. 5 The contour map of soil gas radon concentration (kBqm-3) in Doumen District



The contour map of soil gas radon concentration (kBqm-3) in Zhuhai Area

The statistics of radon concentration in soil gas in Zhuhai Areas($kBqm^{-3}$)

Area		Number	mean	GM	SD	Min.	Max.
DD	QS	120	7.14	4.22	8.75	0.53	64.52
	MSG	20	37.64	29.04	25.93	7.33	88.64
	WG	72	151.25	65.92	196.23	2.13	785.94
ZUA-2002		154	60.97	41.21	54.02	2.93	265.00
ZUA-2003		103	48.41	26.46	64.26	1.20	455.09
ZUA		257	55.94	35.17	58.54	1.20	455.09

Notes: DD-Doumen District; ZUA-Zhuhai Urban Area, QS-Quaternary sedimentary.
MSG-the mixtures of sediment and weather grain of granite; WG-weathered granite.

Comparison of soil radon concentration in Zhuhai City and Other cities

- The dominated intrusive rocks can be grouped into the 3rd stages of Early Yanshanian Period ($J_3\eta\gamma$) in Quanzhou City and Jinjing City, as well as in Zhuhai City, but the mean value of soil gas radon concentration in ZUA is about ten times as large as that in Guangzhou City, Quanzhou City and Jinjing City.

Indoor radon and soil radon prospecting

- **Indoor (by CR-39):**

  0-100 Bq/m^3: 70.6%

  100-200 Bq/m^3: 17.6%

  >200 Bq/m^3: 11.8%

  mean in China: 30 Bq/m^3

Conclusions

- The ratio of radon concentration of weathered granite to Quaternary sediments is about eight.
- Zhuhai City is one of the highest radon potential areas in China.
- The industrial development has considerably changed radon level in soil gas.

What is ongoing?

A research project:

Study on the Methods of Radon Potential Mapping in China

supported by National Natural Sciences Foundation of China (NSFC)

From 2011-2013

See you on the internet websit

http://dept.cugb.edu.cn/ScienceWeb/rel/index.html

Thank you for your attention.