

The background of the slide is a photograph of a modern building with a glass facade, partially covered in snow. The sky is clear and blue. The image is framed by a dark blue diagonal band on the right side, which contains the title text. There are also two red diagonal bars, one on the left and one on the right, framing the central image area.

Current Traditional Stable Isotope Ratio Measurements in China

汇报人 : luhai

Food Safety Laboratory, Division of Chemical Metrology and Analytical Sciences,
National Institute of Metrology, China

目录 CONTENT

01

History of Traditional Stable Isotope Measurements in China

02

Application of Traditional Stable Isotope Measurements in China

03

Organizations on Traditional Stable Isotope Measurements

04

What they want

01

History of Traditional Stable Isotope Measurements in China

China has a long history of stable isotope ratio measurements

- It can be traced to 1930'
 - – although China was involved in wars at that time
 - - Molecular Spectrometry
- 1962 – **First laboratory** (*Joint Laboratory* of Institute of Geochemistry, Chinese Academy of Sciences and Institute of Metallurgical Geology), S
- 1980' – stable isotope ratio measurements were widely applied in geology

Chang Tsinglien



■ 1908.7.31-2006.12.14

Professor, Peking University

Academician, Chinese Academy of science

■ 1983—1989:

Titular member

IUPAC Committee on Atomic Weight and Isotope Abundance

■ **Research:**

- H & O isotopes from 1935
- Atomic weights of C, N, Li, B, S, Ir, Zn, Sb, Ce, Eu, etc.
- 3 Best measurements (1975 - 1985)
- **Developed the first** H & O isotopes CRMs in water in China

Ding Tiping



- 1941 -
Professor, Chinese academy of geological sciences
- 1990s:
Chairman, IUPAC Commission on Isotopic Abundances and Atomic Weights (CIAAW)

Professor Ding is famous for Si measurement by IRMS, and dozens of his students are engaged in stable ratio measurements (C, N, H, O, S, Si)

02

Current Application of
Traditional Stable
Isotope Measurements
in China

STABLE ISOTOPE GEOCHEMISTRY



- mainly studies the abundance and variation of stable isotopes in nature
- explain geological problems such as the source and genesis of rocks and ores.

Studies listed below are included but not limited:

- Origin of deposits, Source of ore fluid
- physical - chemical conditions for mineralization
- ^{17}O -excess
- Distribution of isotopes in earth
- Abundance in different geological bodies
- Their migration, enrichment, decay in geological processes
- Reasons for variation of isotope composition
-

Isotope geochemistry is the *most* prosperous study field in China, Hundreds of institutes, colleges are funded on it.

Tracing the source of water pollution

- Measurement of C isotope in Carbonate in water bodies
- Investigating the general course of water eutrophication
 - Growth of algae
 - Plant by human

Analysis of air pollution Sources

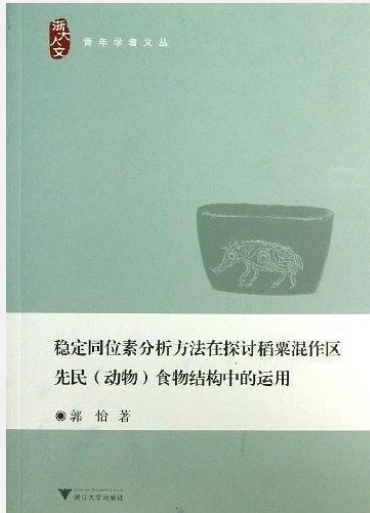
- Measurement of C isotope in PAH (Polycyclic aromatic hydrocarbons), soil, plants
- Comparing their isotopic compositions
- Measurement of S isotope in snow
- Investigating the general course of sulfur
 - Human activity

Tracing the source of soil pollution

- Measurement of C & Pb isotope
- Investigating the general course

Dietary of ancient people

- C, N, S
- bones



Tracing the migration of ancient people

- C, N, H, O
- Bone collagen

Tracing the season & environment when and where people was born

- O
- teeth

Identifying societies of ancient people

- C, N, O, H
- Tomb, House ruins, Cellar hole

STABLE ISOTOPE ECOLOGY



Study field

- Stable isotope fractionation in ecological process
- Application research in ecology

Techniques

- C, N, H, O, S

Sample

- Plants, animals, soils, sediments, carbonates, water and gases




Oil and gas

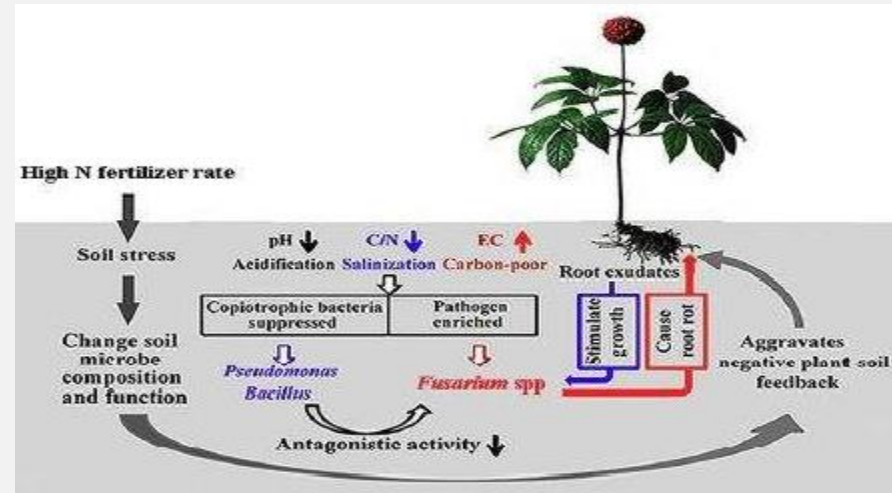
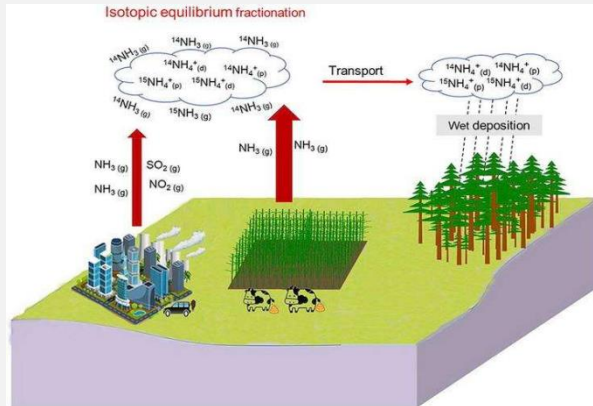
- C isotopes in CH₄
 - the controlling and influencing factors of carbon isotope in methane
 - geochemistry and the genetic type of coalbed methane
 - cause of low $\delta^{13}\text{C}$ value of the coalbed methane
 -

Coal

- C & H isotopes in Hydrocarbons
 - Identification of Natural Gas Genesis and Recovery of Types of Gas Matrix and Its Thermal Evolution Degree

Research started from 1960s, most studies focus on N isotope measurements

- Nitrogen transformation and cycling in soil
 - nitrification and denitrification
 - Nitrogen:
 - Study on Absorption and Utilization and Its Influencing Factors
 - Loss of nitrogen in fertilizer
 - Fixed and reused in soil
- 



Research started from 2010s, most studies focus on C isotope measurements

Techniques

- C, N, H,O
- Compounds specific measurements are rare

Sample

- beef, sheep, honey, wine, tea, potato, onion, milk, alcohol, wheat, Chinese wolfberry, juice and others

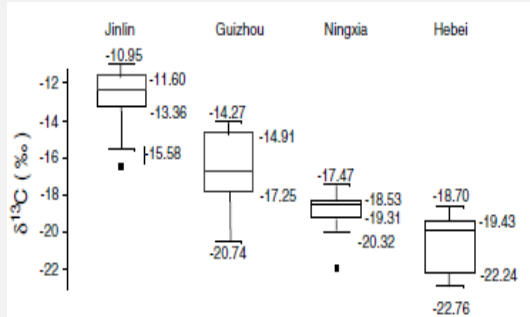


Fig. 2a. The $\delta^{13}\text{C}$ values of de-fatted beef from different regions.

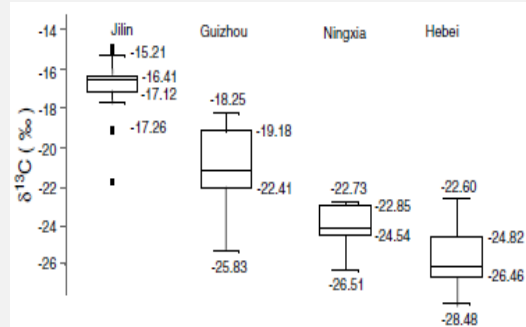


Fig. 2b. The $\delta^{13}\text{C}$ values of crude fat from different regions.

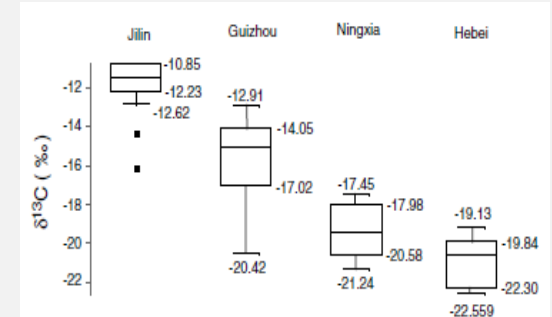


Fig. 2c. The $\delta^{13}\text{C}$ value of tail hair from different regions.

FOOD AUTHENTICITY



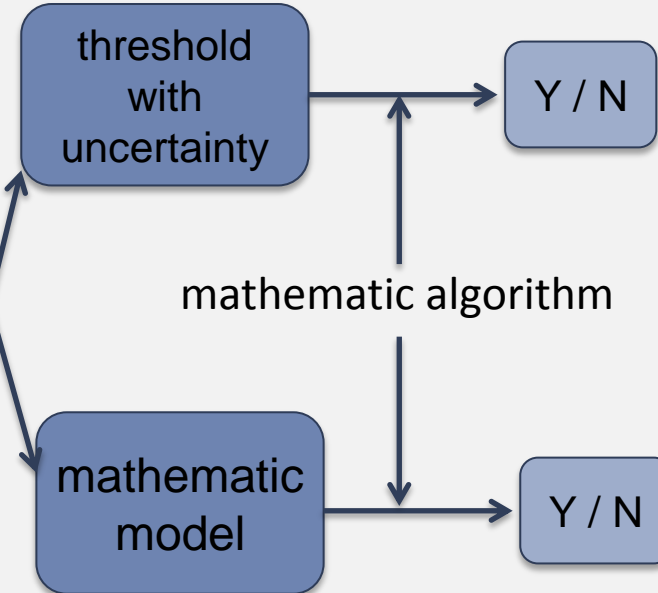
Multi-spectrometry and Characteristic Information Analysis System (MS-CIAS)

1 Framework of MS-CIAS

Multi – spectrometry
with chemical metrology approach

statistic method and illustration

target identification



non-target identification

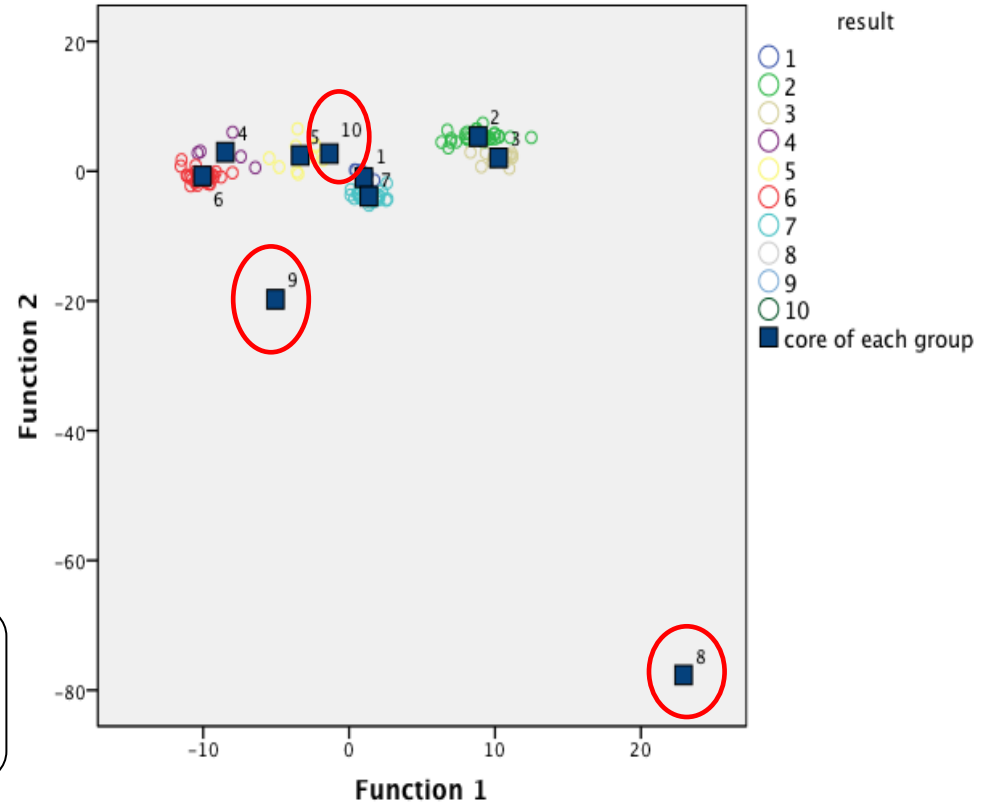
Multi-spectrometry, Multi-dimension information

2 Identification of wine

Validation of MS-CIAS

- **Three wines** were randomly selected
 - No 8. – ShanDong
 - No 9. – YunNan
 - No 10. – ShaanXi
- The data derived from Cabernet Sauvignon in XinJiang was used as STANDARD DATA

- **Accuracy: 100%**
 - All samples are classified correctly



- **Identification of drugs** – conducted by Material Evidence Identification Center of the Ministry of Public Security
- **Identification of endogenous / exogenous dopes** – conducted for Winter Olympic 2020

表 2. 孕酮、睾酮、氢化可的松的 $\delta^{13}\text{C}$ 值测量重复性

名称	$\delta^{13}\text{C}$ 值, ‰	SD, ‰	测量次数
progesterone	-30.45	0.09	5
Testosterone	-28.86	0.12	5
Hydrocortisone	-29.75	0.11	5

* Selected from the report studied by NIM



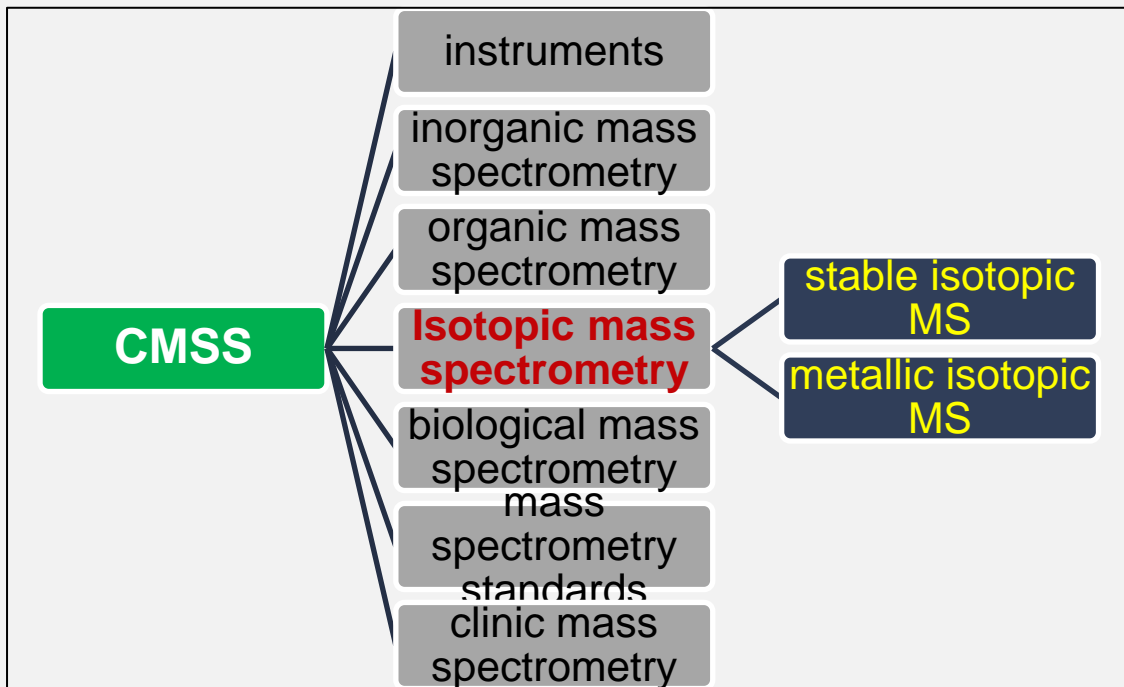
03

Organizations on Traditional Stable Isotope Measurements

Current Organizations on Traditional Stable Isotope Measurements

■ Officially recognized organizations

- China Mass Spectrometry Society



- Geological Society of China
 - 58 branches, including **Isotope geology branch**
- Ecological Society of China
 - 32 branches, including **Stable Isotope ecology branch**
- Chinese Society of Food Science and Technology
 - 7 branches, including **Food Authenticity and Traceability Branch**

Current Organizations on Traditional Stable Isotope Measurements

■ Non - officially recognized organizations

- Stable isotope union of China
 - SIUC was set up at 2017.8
 - No-government organization
 - Scientists come from:
 - geology
 - Ecology
 - Environment
 - energy
 - metrology
 - Agriculture
 -



Current Organizations on Traditional Stable Isotope Measurements

■ Non - officially recognized organizations

● Food Authenticity and Traceability Union

■ Established on 2014

■ comparisons

○ 1 – 2 domestic comparisons every year

2015 年第一轮国内稳定同位素实验室间比对结果

时间: 2015 (第一轮)

样品: 氨基酸

样品编号: 15/R1/C

实验室数量 7
平均值 -33.25
SD 0.23
目标 SD 0.25
最大值 -32.92
最小值 -33.44

15/R1/C (氨基酸)		
实验室编号	测定值	稳健 Z 比分
lab5	-33.44	-0.14
lab6	-33.44	-0.14
lab1	-33.40	0.00
lab15	-33.39	0.04
lab16	-33.23	0.63
lab3	-32.94	1.64
lab2	-32.92	1.71



附圖A-1 参加者结果Z'值柱状图

Comparisons 2019

1、测试项目 (以正式通知为准)

- (1) 氨基酸的碳稳定同位素比值 ($\delta^{13}\text{C}$ 值);
- (2) 白酒中乙醇的碳稳定同位素比值 ($\delta^{13}\text{C}$ 值);
- (3) 橙汁中果肉和总糖的碳稳定同位素比值 ($\delta^{13}\text{C}$ 值);
- (4) 葡萄酒中水的氧稳定同位素比值 ($\delta^{18}\text{O}$ 值);
- (5) 纯水中氧稳定同位素比值 ($\delta^{18}\text{O}$ 值);
- (6) 橙汁中水的氧稳定同位素比值 ($\delta^{18}\text{O}$ 值);
- (7) 葡萄酒中乙醇的碳稳定同位素比值 ($\delta^{13}\text{C}$ 值);
- (8) 氨基酸的氮稳定同位素比值 ($\delta^{15}\text{N}$ 值);
- (9) 小麦粉的氮稳定同位素比值 ($\delta^{15}\text{N}$ 值);
- (10) 纯水中氢稳定同位素比值 (δD 值)。

■ training

- 2017 , symposium on food authenticity and traceability of geological origin by stable isotopes

04

What they want

WHAT THEY WANT



1

▪ **Comparability of Data obtained by different labs**

- In history, scientists (geologists) focus on tendency showed by data, although they are not accurate and systemic error exists.
- Now, scientists realized that data should be compared, thus it can be available in long-term
- reference materials with values can be traced to SI

2

▪ **More international comparisons**

- Few comparisons have been conducted in geology, ecology, etc.
- Scientists have found that data obtained by different labs have obvious variation, thus, they need comparisons to evaluate the ability of labs
- More matrix are needed
- More isotopic compositions are needed

What they want



3

▪ Demand more RMs

- Reference materials with large scale
- More matrix: gas, solid, liquid, etc. for different research area
- Enriched stable isotopic reference materials, e.g. ^{15}N (needed by ecologists for tracing the Nitrogen migration in plants), ^{18}O , ^2H (needed by metrologists)

Temperature redefinition by Triple point of water

$$\Delta T_{\text{iso}} = -A_{\text{D}} \delta \text{D} - A_{18\text{O}} \delta^{18}\text{O} - A_{17\text{O}} \delta^{17}\text{O}$$

NIM are studying the optimum condition by making some mixtures from O & H with different isotopic compositions

Enriched O & H have a wide isotopic range which can not be calibrated by natural reference materials



THANKS

LU Hai:
Tel:86-10-64524763
E-mail: luhai@nim.ac.cn