# 发展土壤碳科学 应对全球气候变化


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# 60th DPI/NGO CONFERENCE

# UNITED NATIOANS, NEW YORK,

Sept 03-07, 2007


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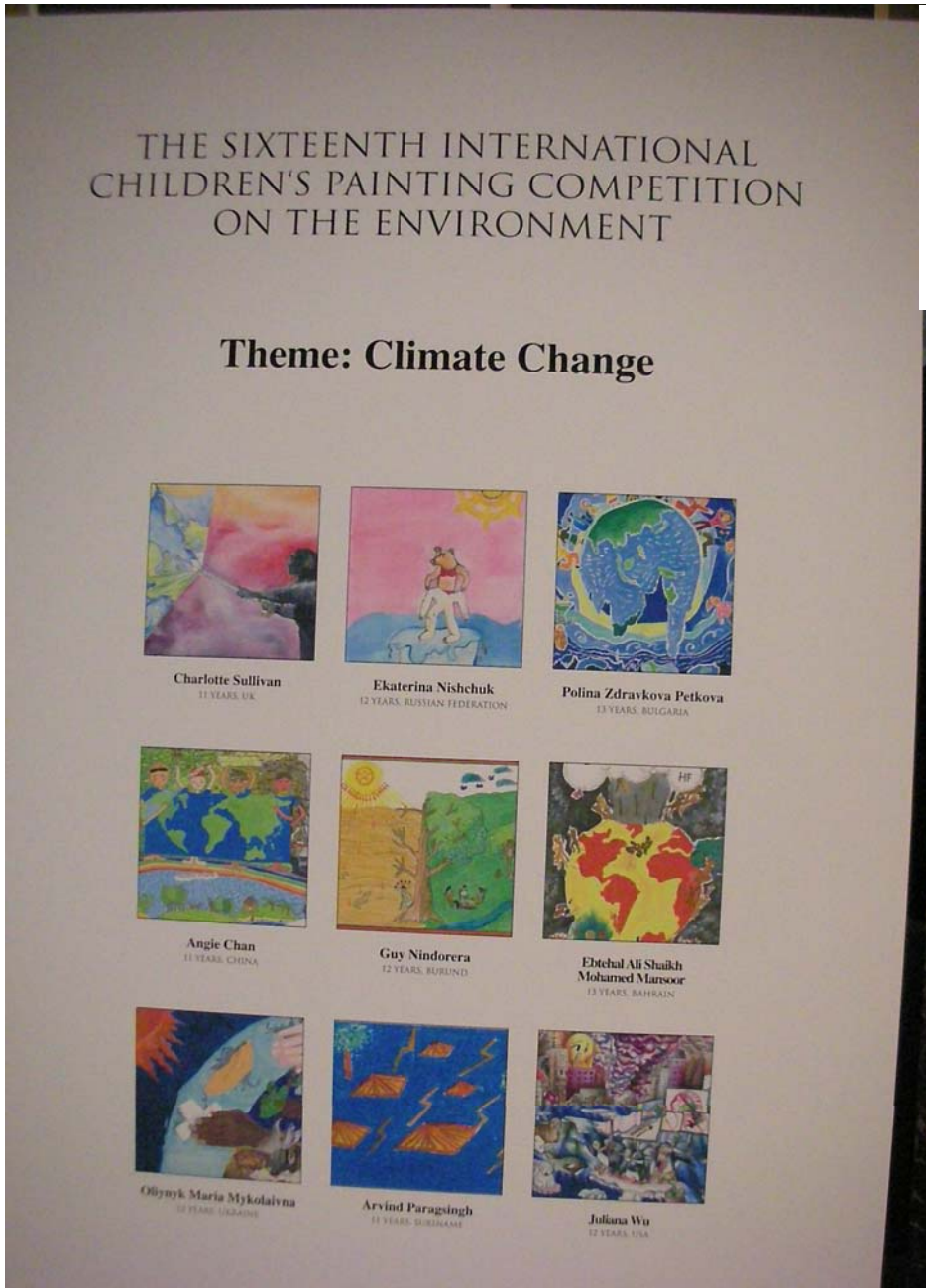
# Climate Change:

# A Global Concern




# 应对气候变化的研究成为国家重大科学需求


**1993**，批准加入《联合国气候变化框架公约》

**1998**，签署《京都议定书》；

**2003**，加入碳收集领导人论坛；

**2004**，《中国国家全球气候变化评估报告》

**2004**，《中华人民共和国气候变化初始国家信息通报 》

**2005**，胡主席出席**G8**峰会，确认气候变化是环境和发展问题

**2007**

**4**月，《气候变化国家评估报告》出版；

**5**月，胡主席**G8**峰会，作出减排承诺；

**6**月，国务院批准《气候变化国家行动方案》；

**7**月，我国开始实施《中国应对气候变化科技专项行动》

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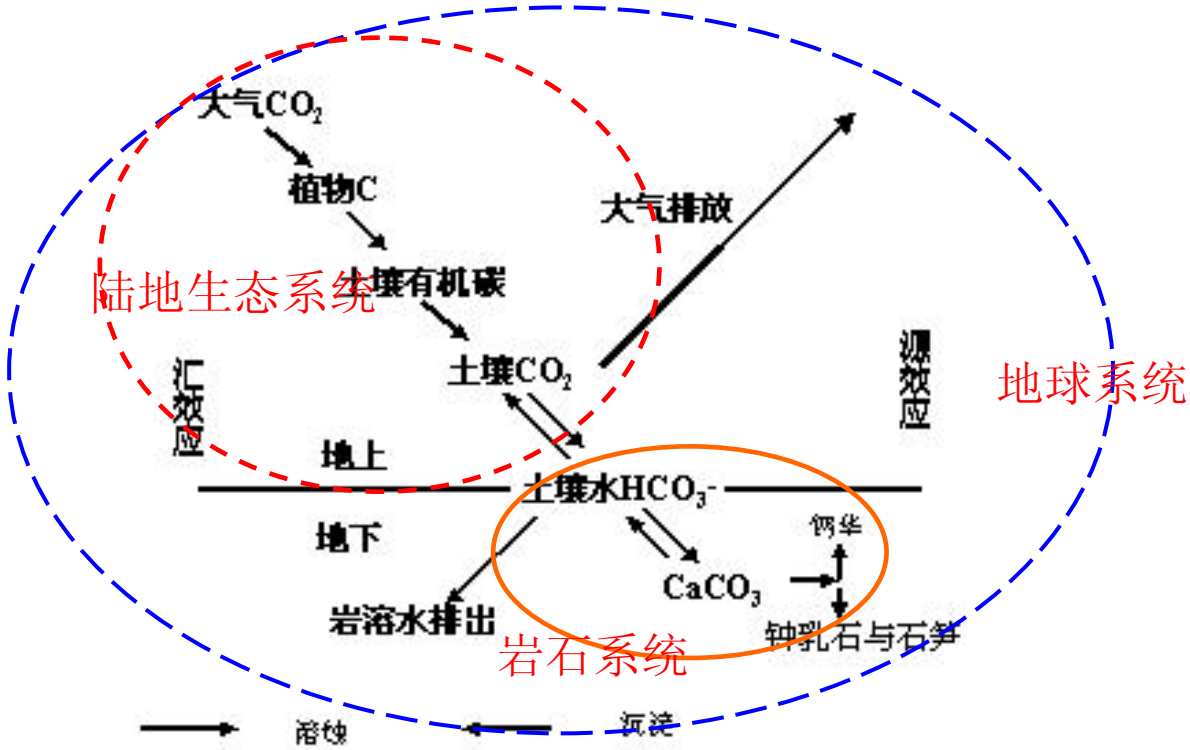
# 魔鬼C与土壤碳科学

碳固定




碳封存

Pan et al., 2002, Chinese Science. Bulletin

**C：地球生物学研究的极好靶标**

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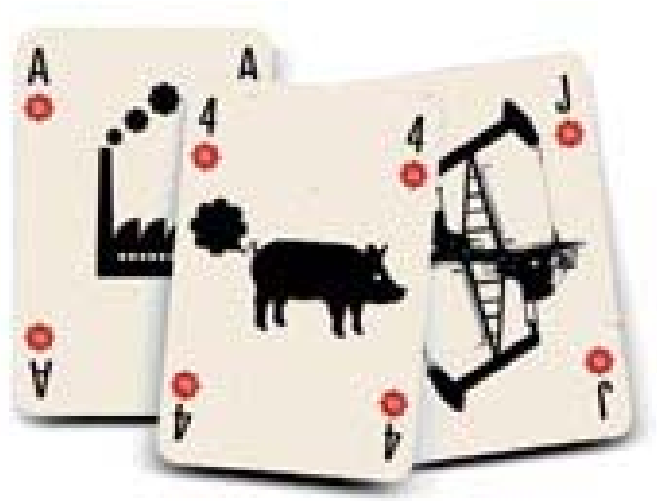
# *碳游戏* 正在热起来

- 低碳经济**(Low Carbon Economy)**
- 碳信用，碳贸易**(Carbon Trading, Carbon credit )**
- 排放贸易（**Emission trading)**
- 清洁生产（**CDM,Clean Development Mechanism)**
- 生态系统碳汇**(Terrestrial Ecosystem C sink)**

ARTICLE SOURCE
nature

# Emissions trading: The carbon game



This summer, a group of power companies in Japan and Canada developed an unusual interest in **pig manure.** The porcine waste was at the heart of a landmark multimillion-dollar deal between Chile's largest pork producer and the power companies, allowing the latter to emit more pollution. The pig farm promised to recycle its animals' emissions of methane — a potent greenhouse gas — by covering the manure, capturing the gas, and burning it as sustainable energy. In return, the power companies bought the right to emit more carbon dioxide from their stations, half a world away from the oblivious pigs.

**Michael Hopkin**

*Nature*, 17 Nov. 2004;
doi:10.1038/432268a

# 土壤固碳作为应对气候变化的重要途径

- 生态系统增汇比(生产过程)减排有效(经济和生态成本）；
- 农田土壤固碳增汇比农业生产的**GHGs**减排有效;
- **IPCC AR4, Chap 8,2007(**农业减排潜力大部分来自农田土壤固碳**)**
- **A final frontier of Soil and Ecology: Science, 2004;**
- **Climate Change, 2007,No1-2**

# Climate Change Science

- Global Change Biology
- C Cycle Science
- $CO_2$ Science
- C Sequestration Science
- Soil Science of C Sequestration

# 土壤固碳科学在美国

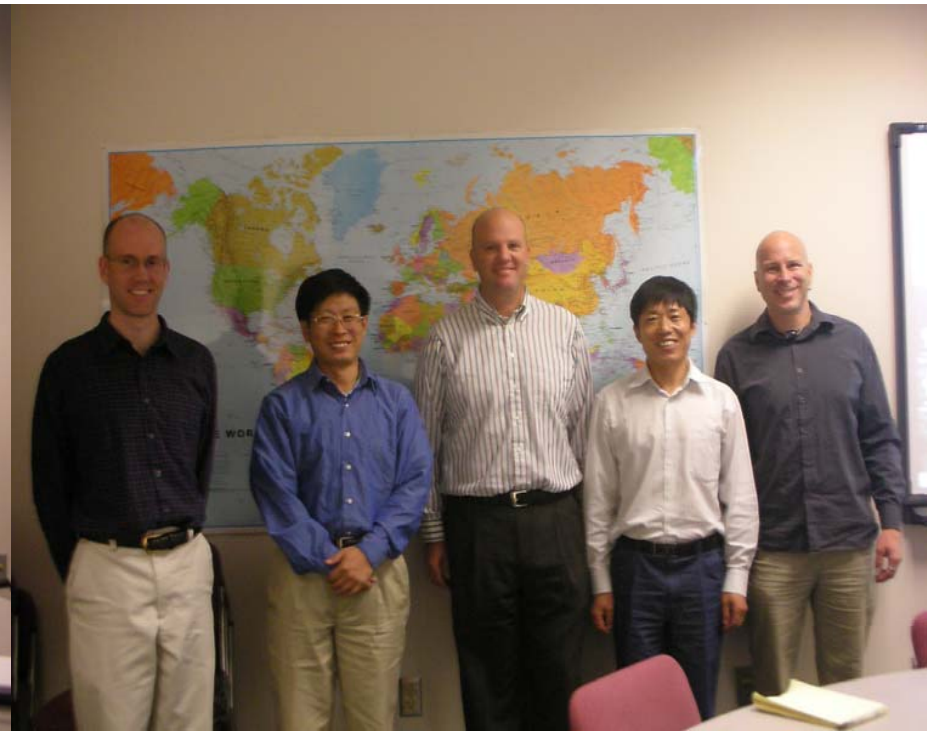
1, Soil C Sequestration Science, Technology, Economy (USDA);

2, **Soil *C Sequestration Center and Partnership (US DOE and NSF);***

3，**Consortium for Agricultural Soils Mitigation of Greenhouse Gases (CASMGS) , USDA-funded and hosted by NREL at Colorado State Univ.**

CF： reducing funds to Savanna River Ecology Lab,

# Visiting CASMGS at NREL, CSU



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NSFC

Office of Science
Science for America's Future
www.science.doe.gov
U.S. Department of Energy

## DOE Carbon Sequestration Centers

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- Research Opportunities
- Data

### DOE Center for Research on Enhancing Carbon Sequestration in Terrestrial Ecosystems

Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Argonne National Laboratory
http://csite.esd.ornl.gov/

### Carbon Dioxide Information Analysis Center

Oak Ridge National Laboratory
http://cdiac.ornl.gov

### C Sequestration Center, Stand Management Cooperative, University of Washington

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# 土壤碳科学：主要研究领域

1, 土壤-农田系统碳计量与碳流分析

2, 土壤碳温室气体产生、释放与减排

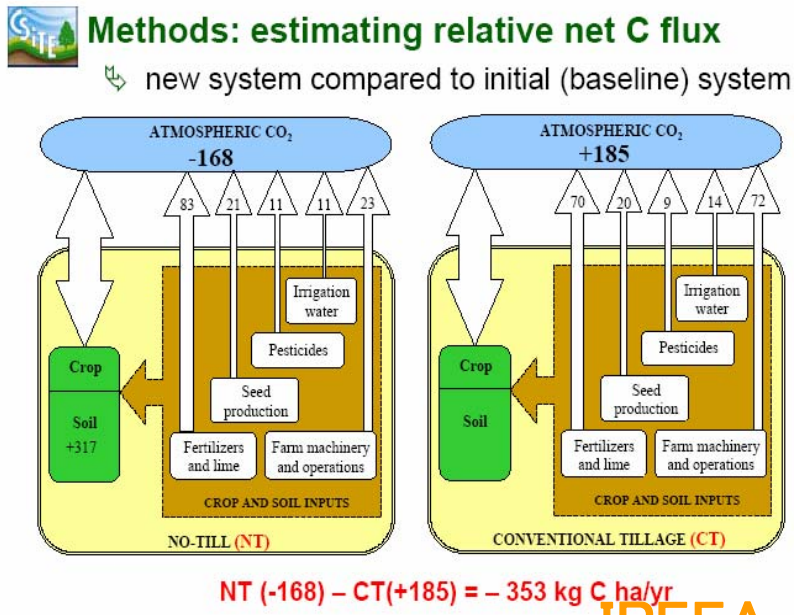
3, 土壤有机碳化学与固碳

4, 土壤-作物-微生物间有机碳的转移与利用

5, 土壤固碳与土壤质量、生态系统功能……

储存量-释放量

稳定性-生物有效性

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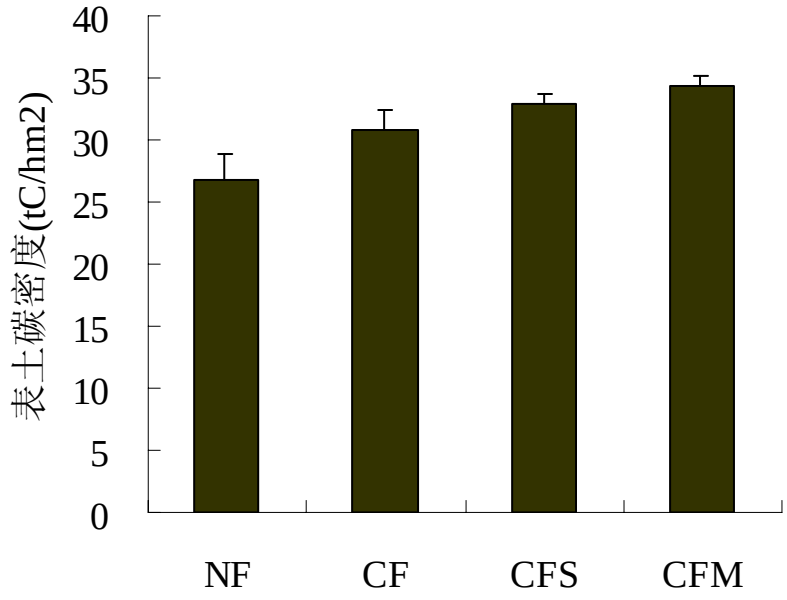
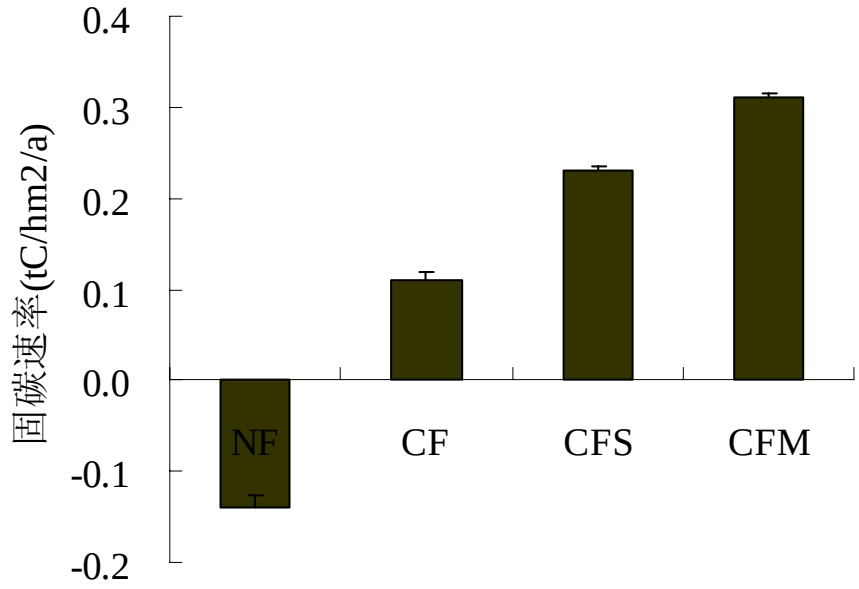
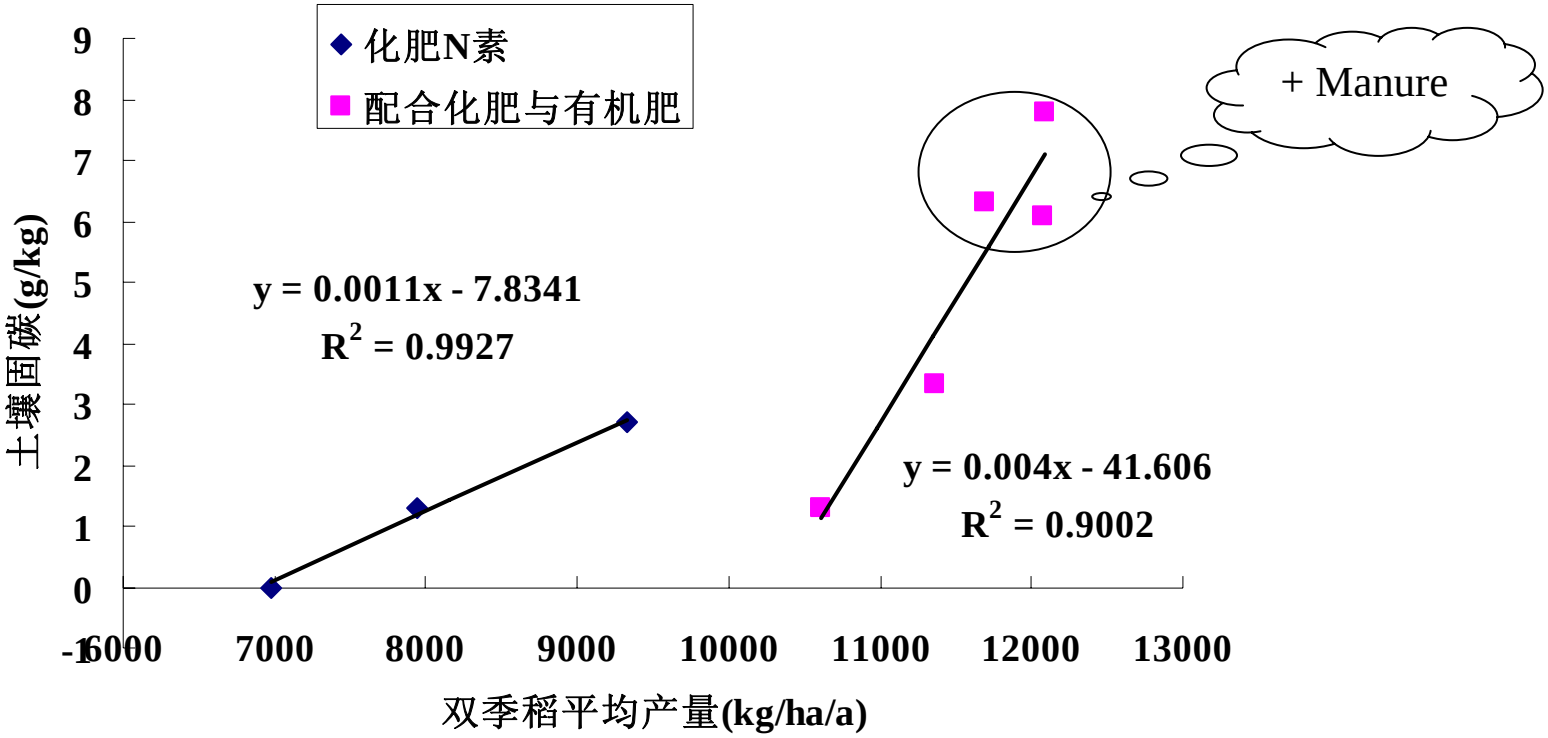
# 太湖地区水稻土长期不同施肥下碳密度与固碳速率




周萍,潘根兴等,生态学报,2006

# Manure application enhanced productivity and SOC sequestration

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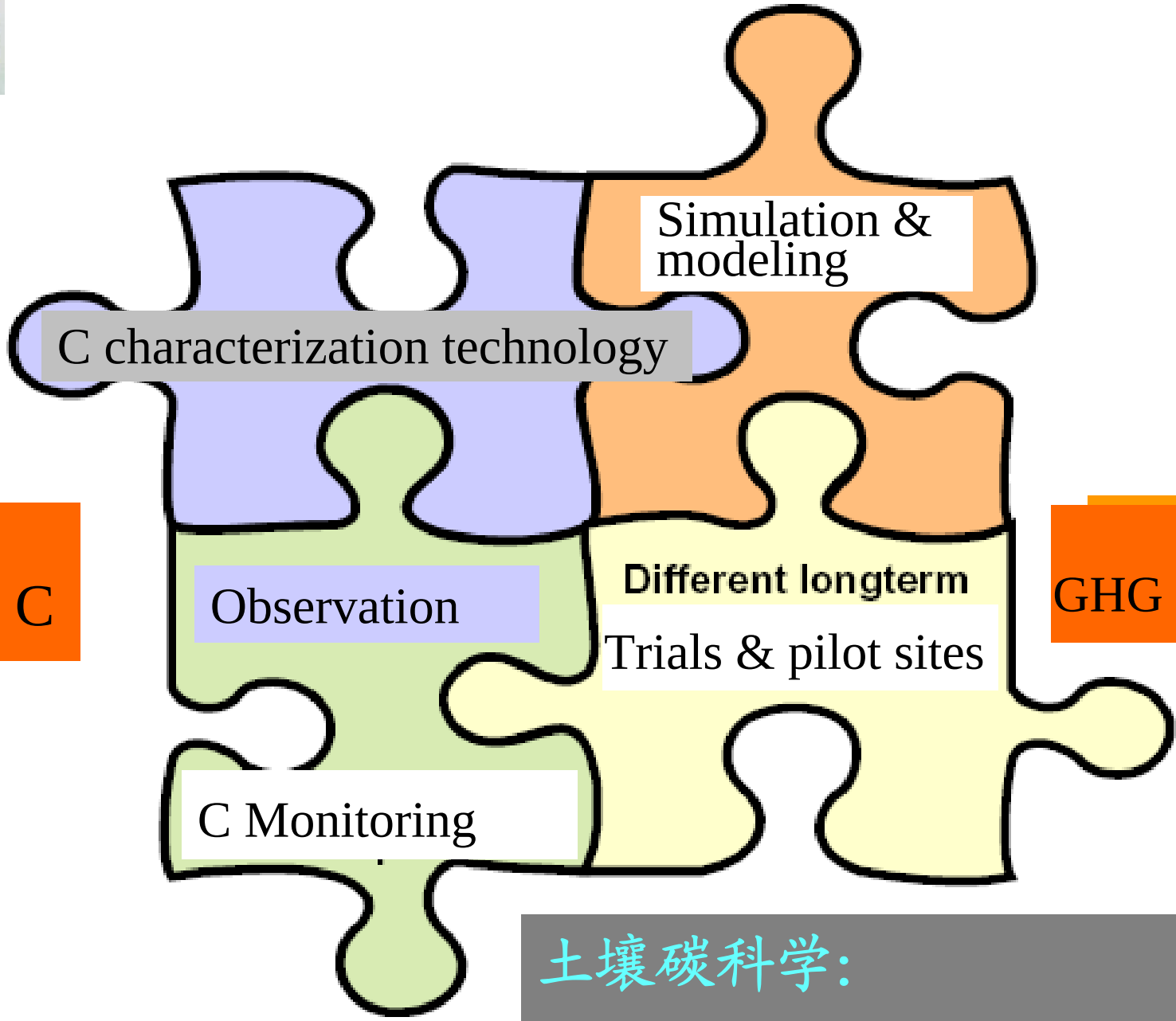


土壤碳科学：

多学科、多途径的整合研究

# 土壤碳科学研究：热点

**1,** 碳库估计及其模型：表征、评估、预测（有机）碳库水平及其变化— **Cquest, EPIC,etc…**

**2,** 碳循环过程与机理：土壤过程与生态系统过程，**Esp.** 有机碳积累与矿化，温室气体释放与农田管理，**etc.…**

模型与模拟：田块尺度与月日尺度：DAYCENT，

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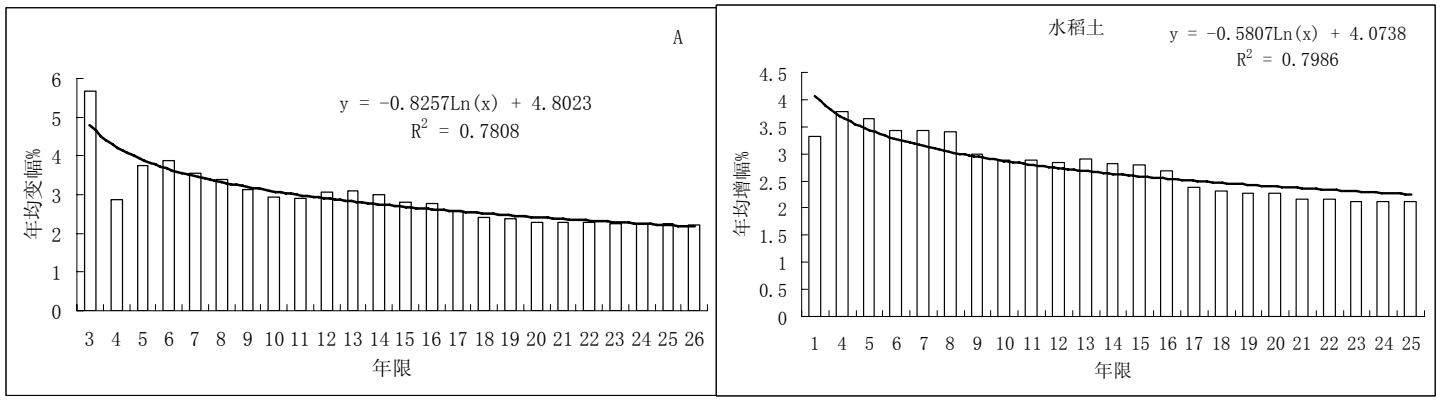
# 土壤碳科学：推动土壤学科发展

- 与生物学的结合：走向地球生物学

  地球系统的生物过程？

- 与数学和统计学的结合：**Meta Analysis**

  例如：有机碳变化幅度的统计



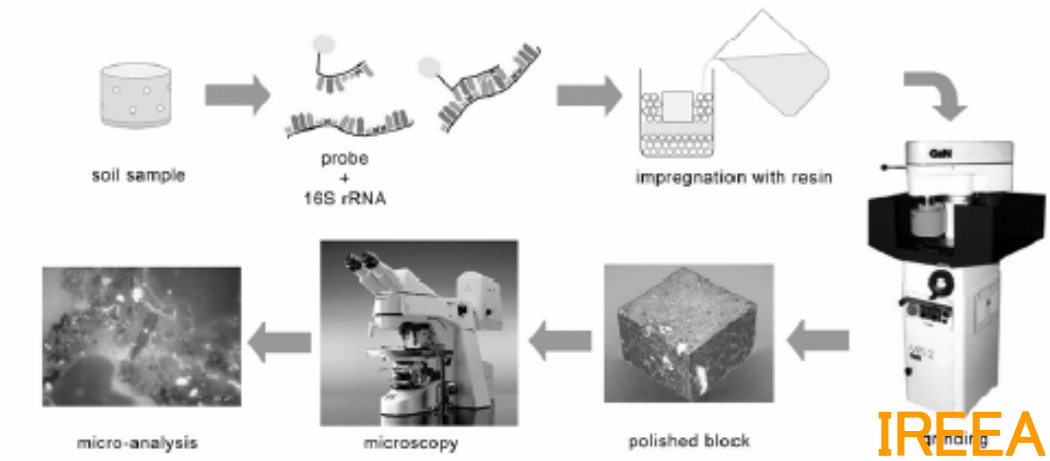
# 土壤碳研究：推动学科交叉、整合

- 整合和凝聚土壤学的分子研究：

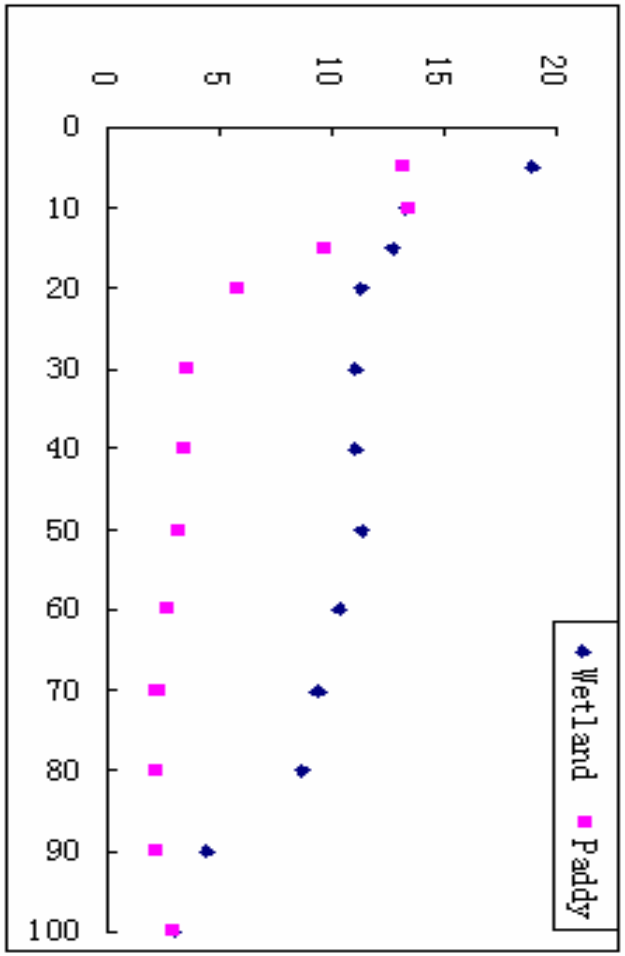
  团聚体层面的科学，土壤物理、土壤微形态、土壤微生境的整合；

- 与土壤发生和土地利用覆被研究的结合：

  尺度与空间变异性；土地利用与覆被变化下的碳库变化等



# 湿地开垦后有机碳库变化




安徽龙感湖湿地开垦为稻田
2~5年后有机碳剖面分布变化

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# 土壤碳科学：过程研究

- 地下部生态系统研究

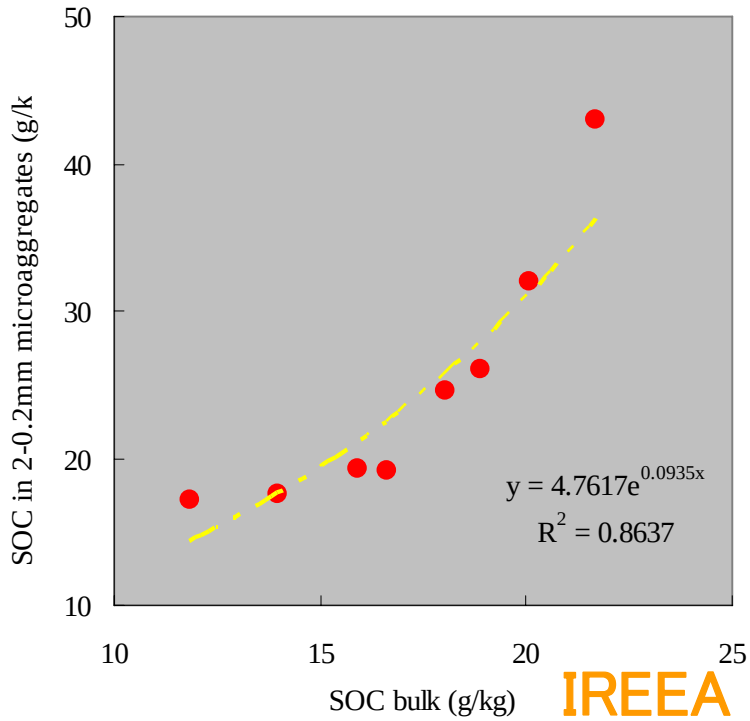
  **Below-ground ecosystem；**

  碳流通,利用,变化等

- **(微) 团聚体与微生境研究**

  **(Micro-) Aggregate/ Particle size fractions.**

  碳结合,稳定,保护等

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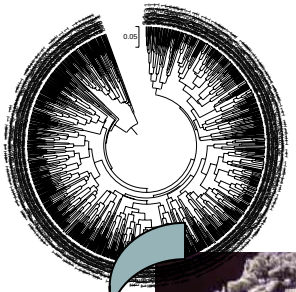
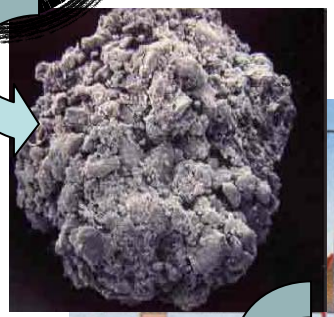
# Below-ground ecosystem and the impacts on SCS








1, Plant role in OM quantity & quality;

2, Selected substrate utilization by microbes;

3, Promotion of soil aggregates for a diverse community

4, SOM protection or stabilization by soil components

5……..

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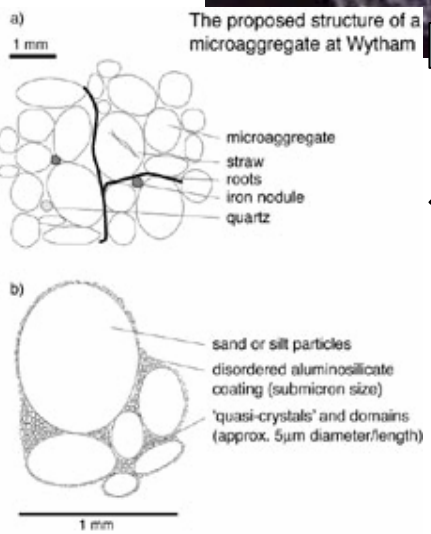
# 团聚体内碳的物理保护、化学稳定与生物利用

The proposed structure of a microaggregate at Wytham



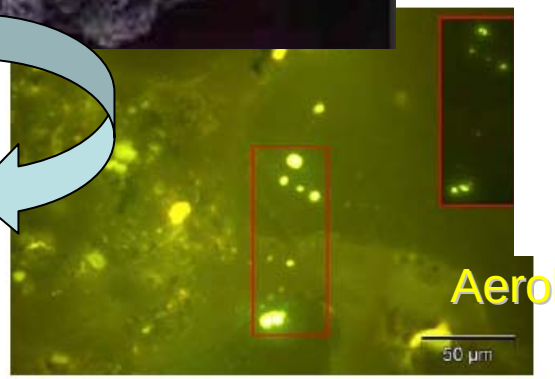
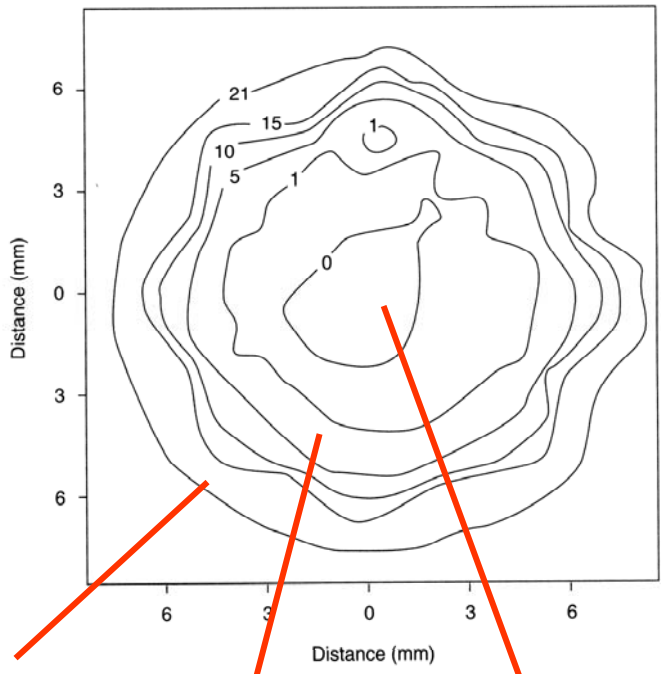




**Fig. 6: Using posthybridization for the detection of bacteria in the matrix of an podzolic soil.**
Objective 40 x; blue excitation.

% Oxygen in a soil aggregate




Aerobic

Microaerophilic

Anaerobic

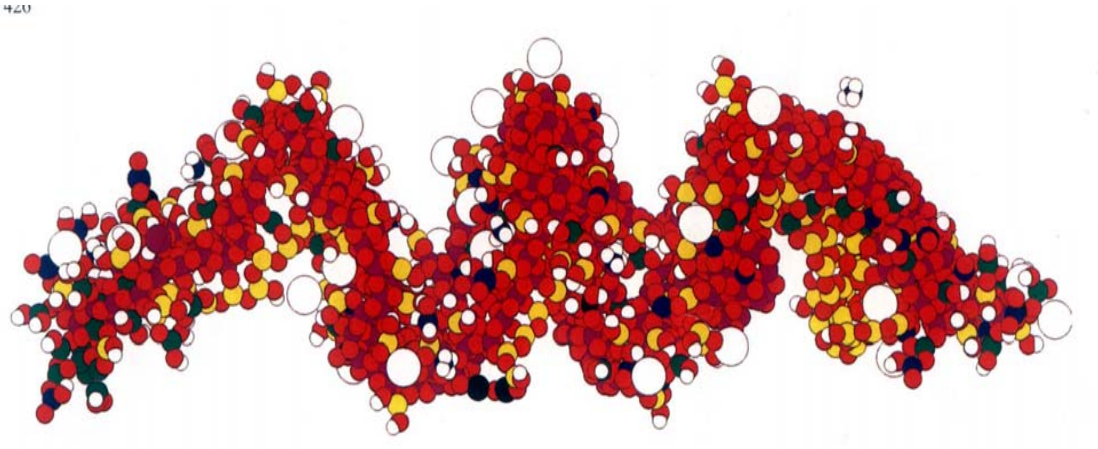
# 土壤碳科学：前沿与尖端

- 超分子结构：

  Super-molecular organic chemistry (Italy) -CP-MAS, Py-GC-NMR

- 分子模拟：

  Molecular modeling (Australia), 计量化学与计算化学



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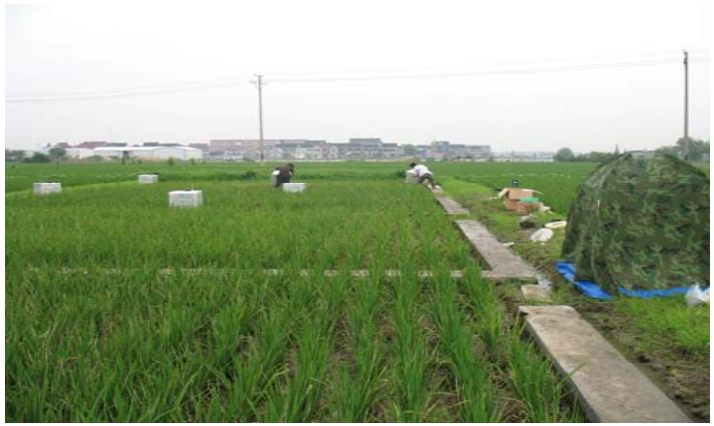
# 土壤碳科学：前沿与尖端问题

- 固碳－温室气体释放－生态系统生产力的耦合关系；
- 有机碳－无机碳－$CO_2$间的共轭联系

我国的土壤无机碳研究相对薄弱



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# 土壤碳科学：知识的创新与革新

- 腐殖质组分

  稳定性组分不一定是老碳：疏水老碳对亲水新碳的固定作用— *黑炭与黑洞*

- 土壤固碳过程

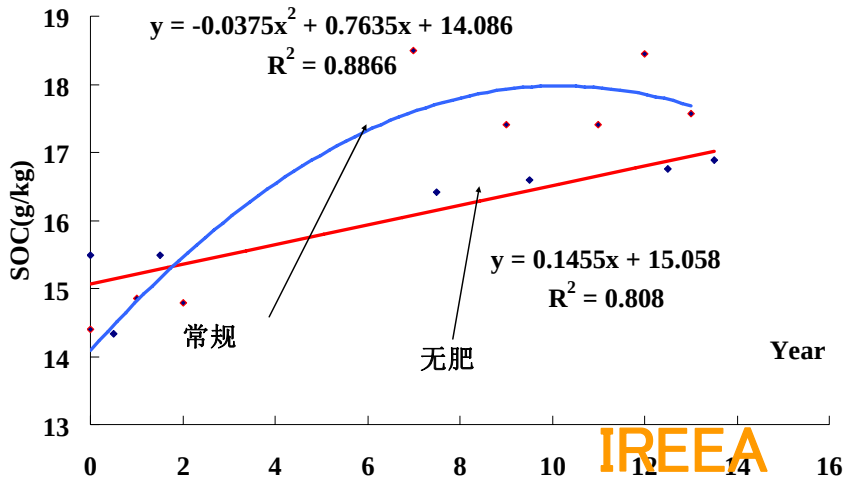
有机碳固定有效时限10～50年，是时间尺度最短的成土过程？

- 碳生物有效性问题：

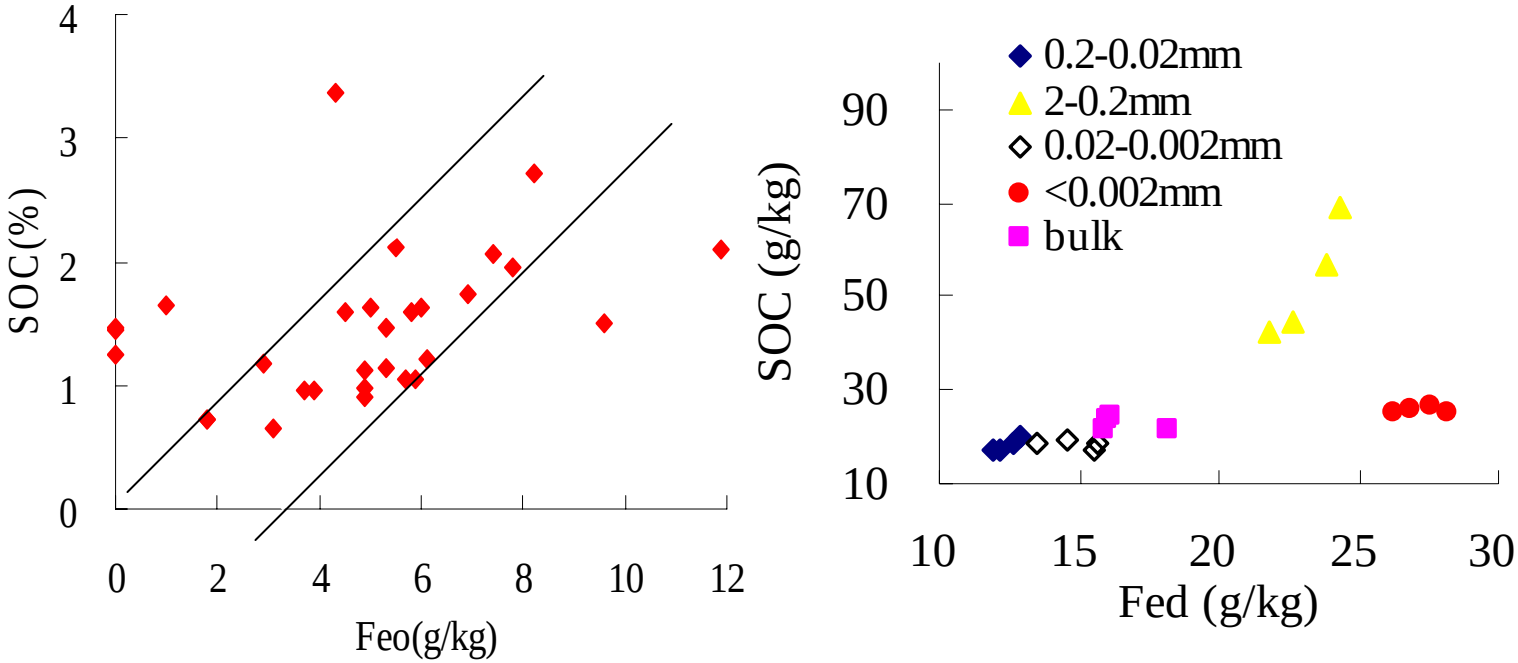
  捕获与固定

- 水稻土中铁的作用？

  成土物质/固碳物质



# Oxyhydrates of iron: an possible active agent for C sequestration in paddys




左：渗育型水稻土SOC 与Feo的关系；右：太湖地区水稻土2-0.2mm团聚体Fed含量与SOC的关系)

# 中国土壤碳科学

## 1, 明确的国家需求：

气候变化国家评估报告、气候变化国家行动方案和应对气候变化科技专项行动(2007)；

## 2, 特殊的科学问题：

- 高度集约化经营下的农田土壤碳(氮)循环过程；
- 固碳减排稳产的碳友好持续农业途径？

- 增汇（固碳）可能更为有效和经济?
- 增汇（固碳）在生态和环境上更安全?
- 增汇（固碳）比减排更符合可持续发展?

# 生态系统土壤需要什么样的碳?

- **SOC?**
- **Charcol  or Biochar?**
- **Lithic C?**

# 土壤碳研究国家计划

## 1, 土壤碳作为非气候变化研究导向:

- 农业与农村发展项目：科技支撑计划;
- 耕地地力与耕地培育：有机质提升计划;
- 十一五发展纲要(农业、资环)：新能源与废弃物治理;

## 2, 土壤碳科学作为气候变化研究导向:

- 应对气候变化科技专项行动：农业固碳减排？;
- **NSFC**全球变化与地球系统（区域响应）;
- **NSFC**土壤碳氮循环与微生物过程;
- **863:** 关注　**973**?

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发展土壤碳科学

推进固碳减排研究

加强应对能力建设

谢　谢