

The background of the slide features a close-up of a hand sowing seeds into dark, rich soil. In the upper center, there is a graphic of a small green plant with several leaves growing out of a green globe that has visible roots. The text 'Remineralize the Earth' is overlaid on this background.

Remineralize the Earth

The climate change solution right under our feet

**History and overview of the global
remineralization movement and future
directions**

Global Repair Conference, May 3-5, 2019 Port
Townsend, Washington

Remineralize the Earth

Facilitates a Grassroots Movement

Remineralization utilizes finely ground rock dust and sea-based minerals to restore soils and forests, produce higher yields and more nutritious food, and store carbon in soils to stabilize the climate.

We facilitate a worldwide movement that brings together gardeners and farmers, scientists and policymakers and the public to create better soils, better food and a better planet.



A Brief History of RTE

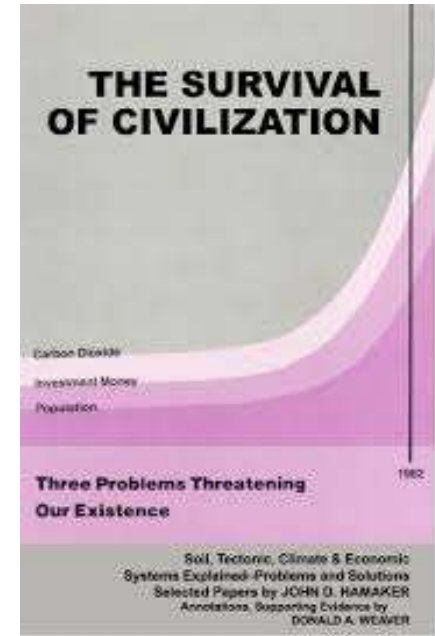


Founder and Executive Director
of Remineralize the Earth

The book that launched
a grassroots movement

*The dirt under my feet
became this vast micro-
universe that supports
all life.*

Joanna Campe



The 1980s Senate CO2 hearings of
Senator Albert Gore and climate
conference



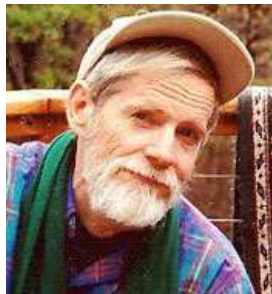
Remineralization Pioneers



John D. Hamaker and Donald A. Weaver, *The Survival of Civilization*



Don Weaver
Earth Health Regeneration



David Yarrow
TERRA, Carbon Negative



Moira and Cameron Thomson
Seer Centre, Scotland



Joanna Campe, 1980s
Remineralize the Earth



Keynote, II Brazilian "Rochagem"
Conference, 2013



Greg Watson Former
MA Commissioner of
Agriculture



Bill Holmberg
American Council on
Renewable Energy



Tom Vanacore
Rock Dust Local



Steve Diver, ATTRA

Agrogeology – Geology in Service of Agriculture

Canada



Bill Fyfe, Pres. IUGS



Ward Chesworth
University of Guelph



Peter van Straaten, University of Guelph and Brazil

Brazil



Othon Leonardos, University of Brasilia



Eder Martins, Embrapa

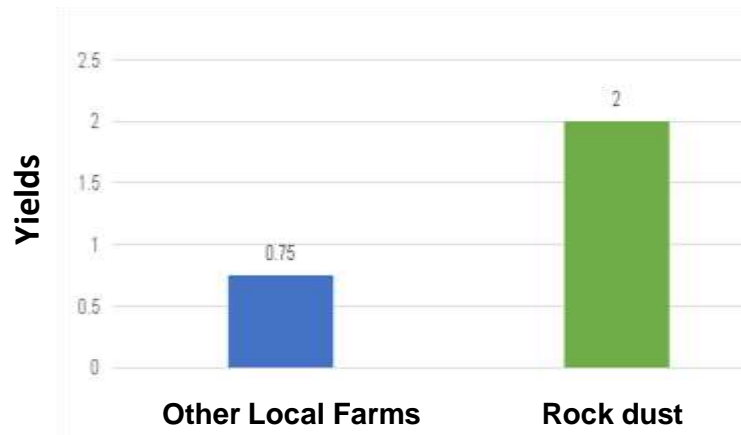


Suzi Huff Theodoro, University of Brasilia

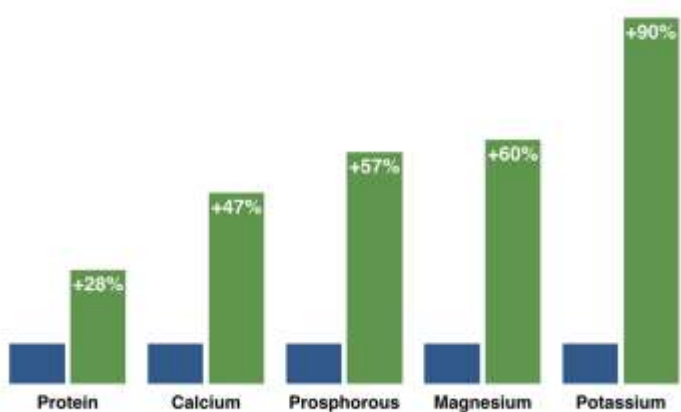


Team from Brazilian Agricultural Research Corp/Temperate Agriculture United and Geological Survey of Brazil with co-researchers from Cameroon and Uganda (Jean Pierre Tchouankoue and Vincent Kato)

John Hamaker Trials with Corn (1976-1977)



Glacial rock dust produced **65 bushels** of corn per acre, compared to **25 bushels** per acre from other local farms – with no irrigation.



From Scarcity to Abundance

Source: John D. Hamaker, co-author with Don Weaver, *The Survival of Civilization* Michigan, 1976-1977

Remineralize the Earth Magazine 1980s-1990s



Forests



Agriculture

European Forestry Studies 1980s-1990s

Long term experiments released in 1986 in Europe showed that in a forest where pine seedlings were remineralized, **after 24 years the wood volume was four times higher** than in the untreated area. One application lasted for 60 years.

Source: Von u. Sauter and K. Foerst. The Bavarian Research and Experimental Institute for Forestry, Munich, Germany, 1986.



Remineralizing a forest in Austria during the filming of a documentary in 1986.



Spruce branches without rock dust taken for mineral analysis (just outside the range of emissions)



Spruce branches with rock dust taken for mineral analysis

Source: *The Effects of Basalt Rock Dust Emissions on Spruce Trees at the Albert Basalt Quarry in Huhnerberg, Germany 1983, Fritz Leipold*

USDA Symposium and Early Studies 1996-1998



A Forum On Soil Remineralization and Sustainable Agriculture at the
USDA Agricultural Research Station in Beltsville, MD, 1994



*Soil Remineralization for an Economically and Ecologically Sustainable
Agriculture, UMASS 1996, Barker, Campe, and O'Brien*

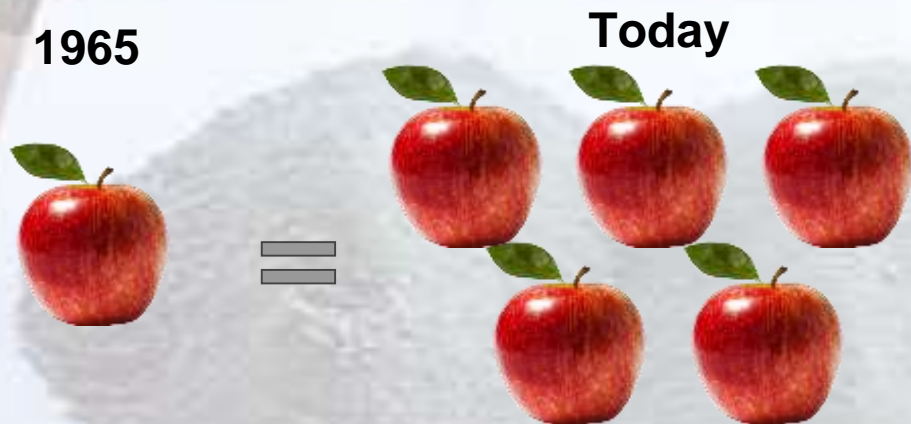


Keynote speaker and founding board
member of RTE, Former Commissioner of
Agriculture for the Commonwealth of
Massachusetts.

From Scarcity to Abundance

Impacting Health and Healthcare

USDA Food Composition Data for Apples



Nutrient Density

On average, you would need to eat 5 apples a day to equal the same nutrition as 1 apple in 1965.

Now imagine increased yields while at the same time enhancing the nutrient quality of the food we eat.

Bionutrient Food Association (BFA)
Developing a handheld bionutrient meter.

Source: Changes in *USDA Food Composition Data for 43 Garden Crops, 1950 to 1999* Donald R. Davis, PhD, FACN, Melvin D. Epp, PhD and Hugh D. Riordan, MD

Remineralize the Earth

The Science

Local to Global Projects

Forestry & Agroforestry

Research Projects

Research Database



The Science

The only online research database
dedicated solely to remineralization

Table 1. Summary statistics of the chemical constituents in soil samples from sites of unhealthy trees in California.

Variable	Mean	Median	Std Dev	Units	N
Al	24.3	5.3	41.7	(ppm)	70
B	0.6	0.4	0.4	(ppm)	119
Ca	1389.0	1201.5	758.7	(ppm)	136
CEC	14.4	12.4	6.6	(meq/100g)	120
Cu	1.6	1.2	1.7	(ppm)	123
Fe	75.4	68.5	78.6	(ppm)	123
K	207.1	180.6	125.0	(ppm)	124
Mg	451.9	363.6	321.9	(ppm)	124
Mn	14.8	11.5	12.9	(ppm)	123
Na	56.3	34.7	86.3	(ppm)	124
NO ₃ -N	11.0	5.7	21.2	(ppm)	120
Org. Matter	4.8	4.2	3.4	(%)	120
P	28.4	13.5	34.0	(ppm)	132
pH	5.8	5.7	0.6		136
SO ₄ -S	21.6	7.0	66.8	(ppm)	117
Sol. Salts	0.6	0.4	0.9	(mmhos/cm)	117
Zn	6.5	2.7	9.4	(ppm)	123

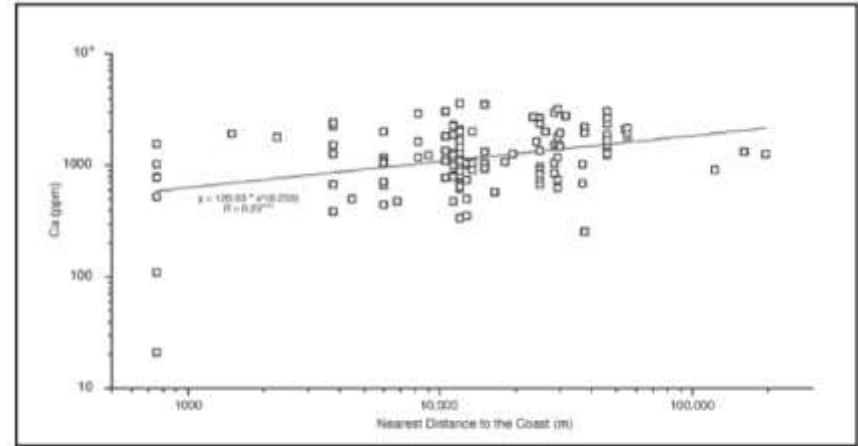


Figure 5. Calcium content of soils in this study as a log-log function of nearest distance to the coast in the sudden oak death-affected regions of California. Best-fit line of the data is a power law function (see equation). R is the regression coefficient; probability (p) $\leq .001$ (***).

***Bryophytes and soil
acidification effects on trees:
the case of sudden oak death
Lee F. Klinger,
PhD***

California - From Sudden Oak Death to Sudden Oak Life



Lee Klinger, PhD

Dr. Lee Klinger is an independent scientist living in Big Sur, California. Since 2005 he has served as director of [Sudden Oak Life](http://www.suddenoaklife.org).



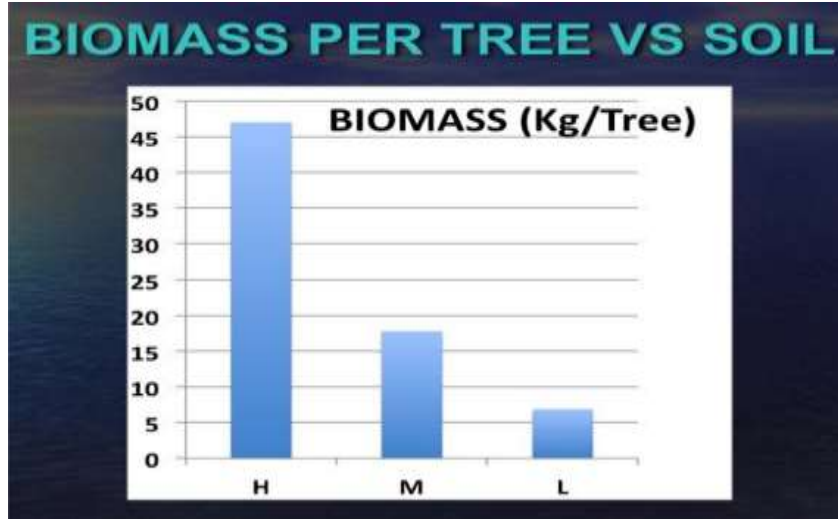
Dr. Klinger's treatment is called 'fire mimicry.'

The Science in Practice – Panama

Basalt Powder Restores Soil Fertility and Accelerates Tree Growth in Impoverished Panamanian Tropical Soils



Dr. Tom Goreau
RTE Board of Directors



H (basalt quarry rock powder), M (transition zone), L (local soil)

Thomas J. Goreau, Marina Goreau, Felix Lufkin, Carlos A. Arango, Gabriel Despaigne-Matchett, Gabriel Despaigne-Ceballos, Roque Solis, & Joanna Campe

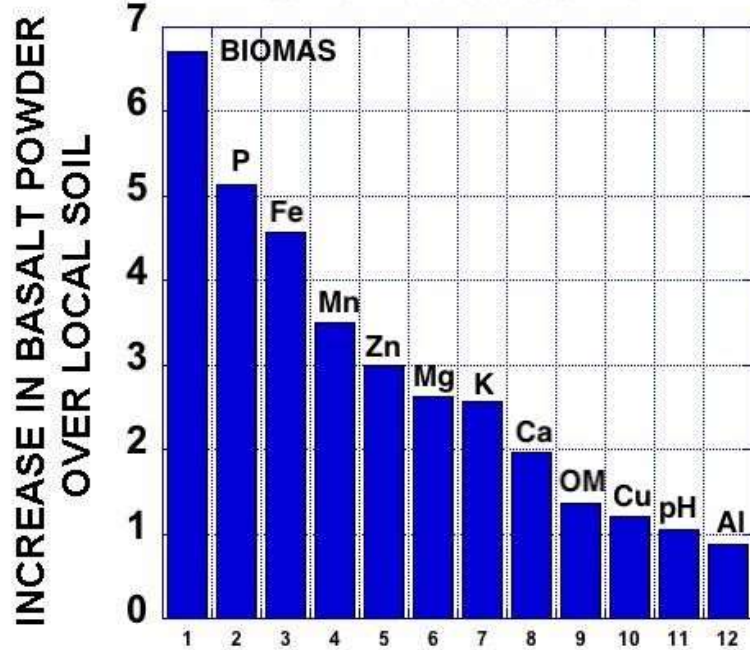
Seedlings of *Acacia Mangium* were planted in September 1997

Results of 5 year study

- 8-fold increase in biomass
- 2.17 increase in the height of the trees
- 4 times the survivability from the trees on basalt
- The trees on the local soil did not survive

Chapter 17, *Geotherapy Innovative Methods of Soil Restoration Carbon Sequestration, and Reversing CO2 Increase*, 2015, Taylor and Francis Group, LLC

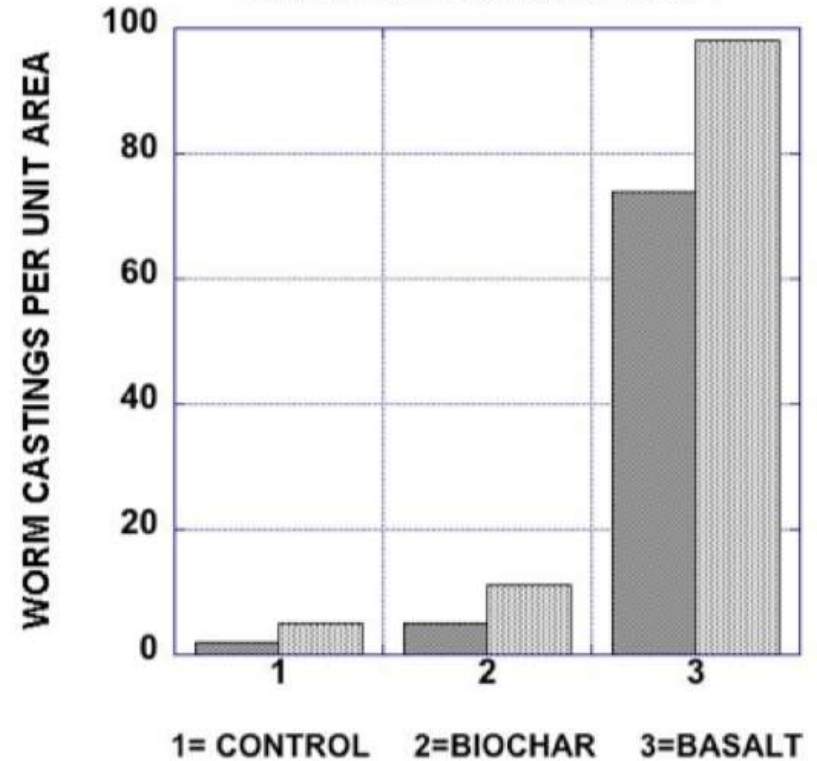
BASALT POWDER VERSUS LOCAL SOIL **CANTERA PEDRERA, PANAMA** Data from Goreau et al. 2014

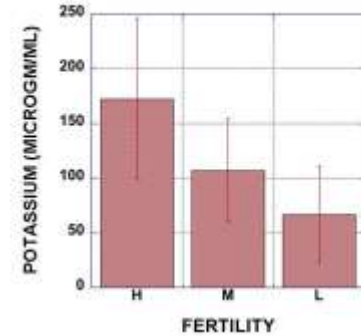
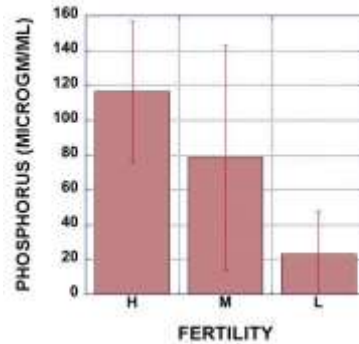
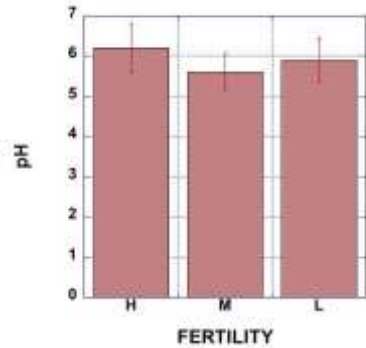
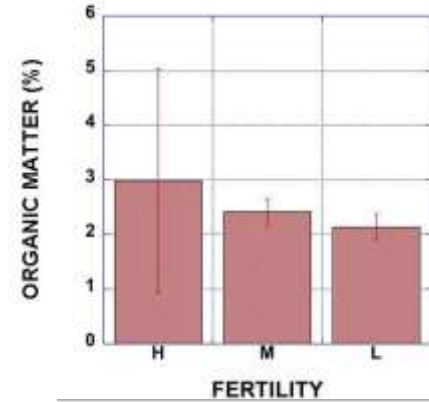
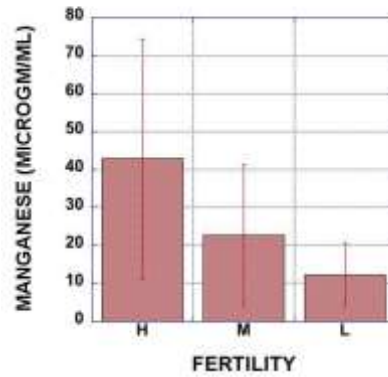
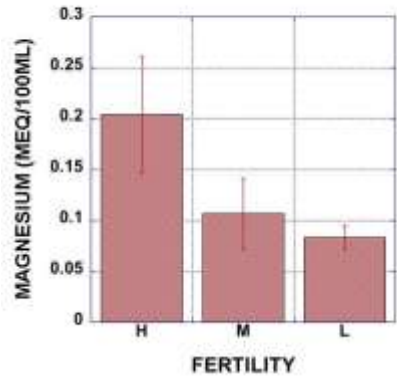


The value of that parameter in basalt powder (growth rate, concentration) divided by the value in local soil.

Goreau et al., 2014

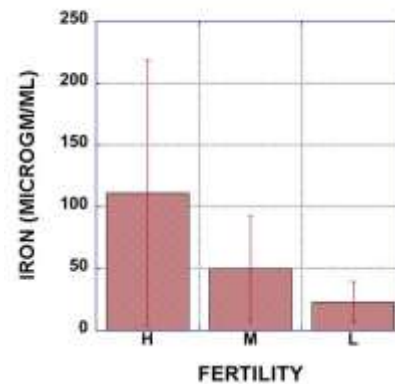
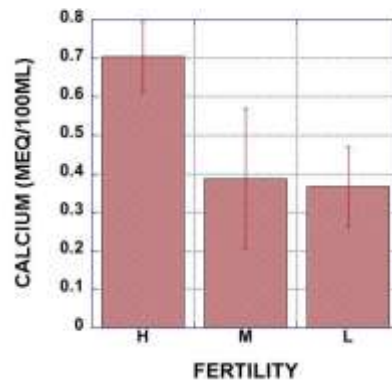
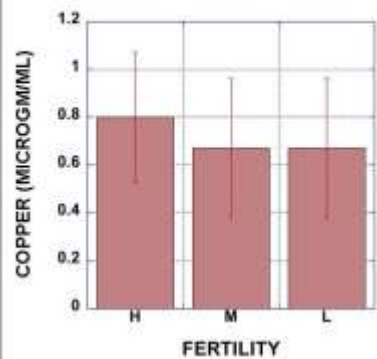
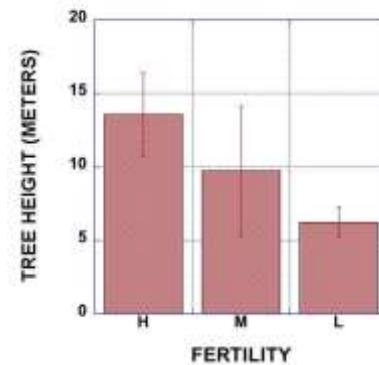
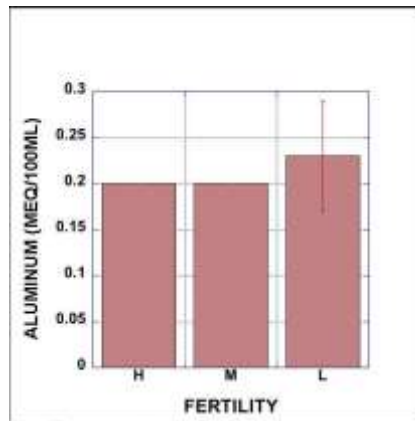
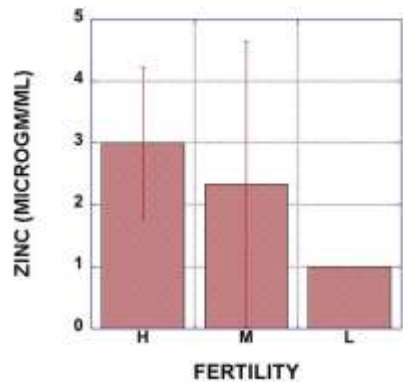
EARTHWORM ACTIVITY





Panama

H (basalt quarry rock powder), M (transition zone), L (local soil)



Panama

H (basalt quarry rock powder), M (transition zone), L (local soil)

Our Vision: Creating Partnerships

International Projects

Forestry & Agroforestry

Research Projects

Research Database

Portable Rock Crushers

Networking Brazil



RTE is Facilitating the Paradigm Shift and Movement

Local Projects: Educational Models, Community Projects, and Research



Class research project of Paulo Freire Social Justice Charter School



Staking the plots for Aji Peppers

RTE is Facilitating the Paradigm Shift and Movement

University of Massachusetts



Professor Stephen Herbert, with Brix Meter indicating nutrient density.

New Harmony Farm CSA



Thomas Goreau, PhD weighing the harvest to get the yield.

RTE is Facilitating the Paradigm Shift and Movement

International Projects



CUSAN - Cuba Delegation



Heifer International - Sahel region, Senegal



Monserrat's Volcanic Ash in Barbuda

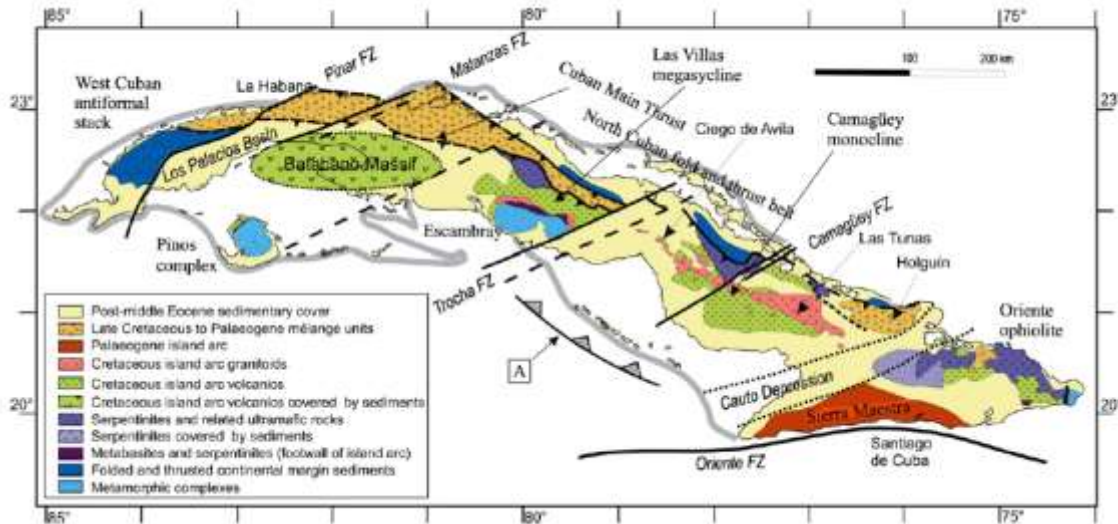


Bahia Research Project -- UnB,
dryGrow Foundation, RTE

Cuba

5th International Conference of Agroecology and
Cooperatives November 22-27, 2015
Dr. Tom Goreau, Joanna Campe, and Greg Watson

Using Local Sources of Rock Dust



Basalts, Granites, Sedimentary rocks are locally available.

Innovative Portable Rock Grinder



Small portable biodiesel rock grinder ideal for community stakeholder projects that can be adapted to a solar array.

Brazil

Agroecology
Movement

+

Research
and Policy
Making



Research at Embrapa with Eder Souza Martins, PhD

**Embrapa research
with rock dust in
twelve regions of
Brazil.**

**Geological
resources are
being mapped from
the air.**



Brazil Enacts Groundbreaking Legislation for Sustainable Agriculture



Team from Brazilian Agricultural Research Corp/Temperate Agriculture United and Geological Survey of Brazil with co-researchers from Cameroon and Uganda (Jean Pierre Tchouankoue and Vincent Kato)



Suzi Huff Theodoro, PhD
II Congresso Rochagem 2013

Brazil is the emerging leader for remineralization in the research and public policy arena.

Laws Enacted in Congress

- 1) Rock dust as a fertilizer (Law 12.890/2013)
- 2) Certification for rock dust products (Decree 8.384/2014)

Remineralization of Soils to Increase Production of Cactus for Fodder in the Semi-arid Regions 2016-2018

Doctoral student Fernanda de Paula Medeiros & Senior Collaborating Professor of the University of Brasilia (UnB), Suzi Huff Theodoro



In Bahia, Brazil, remineralization was used to enhance the production of two species of cactus for fodder:

- "Giant" *Opuntia ficesus-indica* (L.) Mill.)
- "Sweet" (*Nopalea cochenillifera* (L.) Salm-Dick.)

After 12 months, the yields surpassed the productivity of the region for these species.

- Availability of phosphorus, potassium and micronutrients was increased.
- There was a reduction of iron and aluminum.

Best results occurred in the blocks with the rock dust + organic compost mixture.



Increasing Production of Cactus for Fodder

Test Results for the First Year

- 3.888 times the growth for the rock dust + compost versus the control.
- The pH of the soil has been improved by the **four-fold increase of calcium** and the **two-fold increase of magnesium** as seen in the graph on the lower right.



Experimental Randomized Block Design



Figure 01 - Experimental Unit design, where G: Giant Cactus (*Opuntia ficus-indica* (L.) Mill.) and D: Sweet Cactus (*Nopalea cochenillifera* (L.) Salm-Dick), and the treatments 1: Control; 2: Remineralizer; 3: Remineralizer + Organic Compost; 4: Organic Compost.

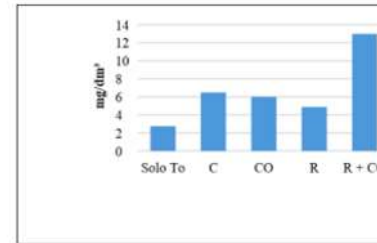


Figure 05 - Temporal analysis of the initial availability of phosphorus and after one year under different treatments.

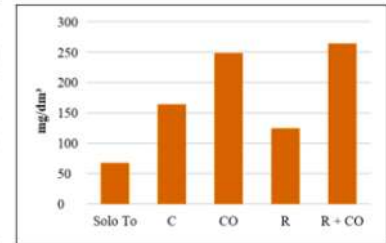


Figure 06 - Temporal analysis of the initial availability of Potassium and after one year under different treatments.

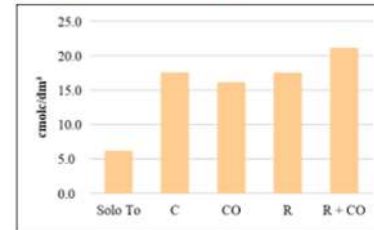


Figure 07 - Temporal analysis of initial calcium availability and after one year under different treatments.

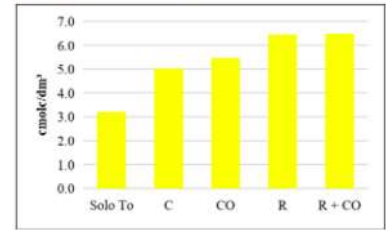


Figure 08 - Temporal analysis of initial magnesium availability and after one year under different treatments.

Increasing Crop Yields in Mexico

Remineralization of 22,000 hectares with government subsidies (Zacatecas, 2008-2009)



Zapopan, Jalisco



Agro Insumos Nova Terra SA

After a huge decline in bean production in 2002-2007, Urea was replaced by rock dust and **production was increased by 300%.**

Also increased production of corn, grape, peach, nopal and several varieties of chili pepper.

ECOAGRO

Farmer's Collaborative at the Forefront



**30,000-40,000 hectares
have been remineralized**

Sinaloa, Mexico

Enhancing Food Security from the Brazil to the Caribbean Through Agroforestry



Jua Pereira
Sítio Semente student
of Professor Suzi Huff
Theodoro PhD and
Ernst Gotsch



Ernst Gotsch— Swiss farmer, researcher, and
master teacher based in Brazil



www.agendagotsch.com

<https://vimeo.com/136423275>



www.sitiosemente.com

Less work, higher production

**Only one initial application of rock dust
and no outside inputs thereafter**



Restoring highly degraded land outside of
Brasilia with agroforestry

**20-30% more humid
during the dry season
than the surrounding
areas**



Banana trees and eucalyptus
fertilize the vegetable beds

Agroforestry Systems Workshops



System Transition

Vegetables -> Fruit trees -> Cacao,
Coffee & Papaya





**Remineralization incorporated
into agroecology**

From Food Forest to Farmers Market



Greenland's Glacial Mud Could Remineralize the Tropics



Professor Minik Rosing speaking at Tedx Cannes on November 9, 2016

We Need to Remineralize on a Vast Scale

Remineralize the Deltas – De-acidify the Oceans

**Greenland's Perspective Initiative Partnership
to create food security in the tropics**

Greenland glacial mud



Bringing Remineralization into the Mainstream

Major Art Installation



***Glacial Rock Flour Garden, Palace of Versailles
Olafur Eliasson. 2016***

*Photo courtesy: Anders Sune Berg. neugerriemschneider,
Berlin; Tanya Bonakdar Gallery, New York
© 2016 Olafur Eliasson.*

Our Mission: Covering all the Bases



Farming, Dairy & Livestock



Carbon Sequestration



Bioremediation



Pest Control



Stabilizing the Climate



Sustainable Biofuels

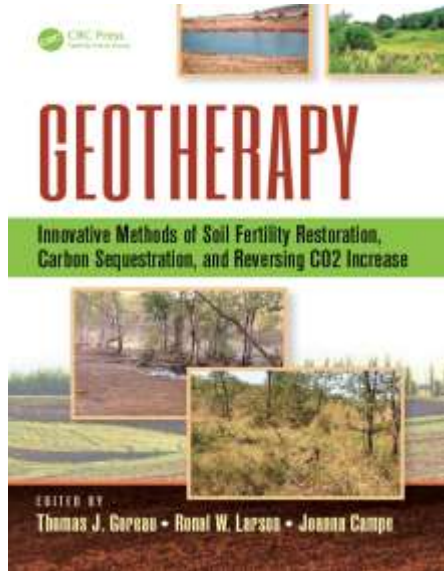
Remineralize  the Earth

Our Mission: Facilitating Networks



United Nations
Framework Convention on
Climate Change

Geotherapy Book



Geotherapy Blog

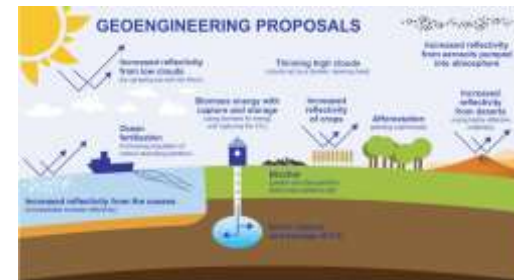
Explore RTE's Blog containing new research studies with comprehensive data showing the benefits of rock dust and biochar.



Pioneer Spotlight: Steve Diver at the University of Kentucky



Montserrat to Barbuda— one island's volcanic ash could enrich another island's soil



The Ethics of Climate Change: Geoengineering and Geotherapy

Our Vision: Current and Future Directions

Let's Remineralize! Science Ed K-12

Stone House Farm – Hudson Carbon

Equinox Farm – Berkshires, MA

Agroforestry Projects – Post-Hurricane Caribbean

Preventing Forest Fires through Remineralization



Let's Remineralize! Giving Teachers the Tools to Educate a New Generation of Eco-Warriors



Students become junior scientists who will explore, experiment, and gain knowledge on multiple subjects such as geology, agriculture, botany, sustainability, and nutrition. They will collect data on an easily-obtainable natural resource, performing simple to more complex science experiments either indoors or outdoors — in school gardens, greenhouses, and with grow lights in a classroom.

Classes from all over the world will share their results, including text, photos and videos of the experiments, which will be added to a GIS world map on RTE's website.

Stone House Farm and Hudson Carbon



Stone House Farm was purchased and developed by Peggy McGrath Rockefeller, a visionary and an activist in the cause of preserving American farmland and ensuring the survival of American agriculture.

Stone House Farm is dedicated to demonstrating a viable model of regenerative organic agriculture and to the development of a resilient agricultural economy in the Hudson Valley and greater Northeast. Their farm has transitioned from conventional corn and soy production to being a diversified organic farm. They integrate their cropping and grazing systems to rebuild their soils and minimize their use of off farm inputs.

Stone House Farm will be partnering with Remineralize the Earth and Rock Dust Local to integrate rock dust and biochar and measure carbon sequestration

Stone House Farm – Hudson, NY

Studies with rock dust and biochar for commodity crops and holistic grazing

Ben Dobson, Farm Manager of Stone House Farm
Director, Hudson Carbon

Dr. Jim Tang, Researcher
Woods Hole Oceanographic Institute

Tom Vanacore
Rock Dust Local

Dr. Tom Goreau and Joanna Campe
Remineralize the Earth



Equinox Farm – Sheffield, MA

Studies with rock dust and biochar for cannabis (for CBD oil)

Ted Dobson, Farmer
Equinox Farm

Dr. Jim Tang, Researcher
Woods Hole Oceanographic Institute

Tom Vanacore
Founder of Rock Dust Local

Dr. Tom Goreau and Joanna Campe
Remineralize the Earth

EQUINOX FARM



University of California Davis receives \$4.7M to Study Carbon Sequestration

Rock Dust + Compost +Biochar



An exciting new consortium led by the University of California, Davis, and the UC Working Lands Innovation Center is setting out to find new and more improved methods of taking out excess carbon dioxide from our atmosphere by adding amendments such as rock dust, compost, and biochar into California's soil.

The studies will assess whether soil amendments can bring additional benefits to California farms, such as improved soil health and crop and rangeland productivity.

Wildfires on a Vast Scale Worldwide



Greece 2018 (National Public Radio)

The widespread fires this year have magnified concerns that we are locked in a worldwide pattern of conflagration that is both persistent and catastrophic.

The Earth Ablaze

The New York Times

August 8, 2018

Destructive and deadly wildfires of enormous size raged in California, Chile, Argentina, British Columbia, Portugal, United Kingdom, Sweden, Denmark, Estonia, Finland, Latvia, Malta, the Netherlands, Poland and Germany.

Remineralize Forests on a Vast Scale

Research, Outreach, and Policy Making

Remineralizing forests will increase resistance to insects, disease, frost, and drought.



Lake County, CA (LA Times)



Remineralized forest in Brixlegg, Austria (1986)

Mount a Campaign

Remineralize forests from the air— mobilize local, state, federal, National Guard, or other means.

California Gov. Gavin Newsom declares state of emergency, promises funding due to increased wildfire risk



Rich Pedroncelli | AP

Gov. Gavin Newsom discusses emergency preparedness during a visit to the California Department of Forestry and Fire Protection CalFire Colfax Station Tuesday, Jan. 8, 2019, in Colfax, Calif.

On January 8, 2019, California Gov. Gavin Newsom declared a statewide emergency Friday as result of “a vast tree die-off throughout the state” and deteriorating forest conditions that have increased the risk of wildfires.

The governor announced earlier this year that:

- the state will spend \$1 billion on forest land management over the next five years, with funding coming from proceeds from California’s cap-and-trade auctions.
- the state will propose to spend more than \$300 million to upgrade its planning and response to wildfires and other disasters.





Thank You!



Joanna Campe
Founder and Executive Director
jcampe@remineralize.org
www.remineralize.org

Sudden Oak Life



EQUINOX FARM

