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FONDO NACIONAL DE DESARROLLO CIENTIFICO Y TECNOLOGICO (FONDECYT)
Moneda 1375, Santiago de Chile - casilla 297-V, Santiago 21
Telefon: 2435 4350 FAX 2365 4435
Email: informes.fondecyt@conicyt.cl
MODIFICACIONES ACADÉMICAS

El informe no presenta modificaciones académicas.
PROJECT RESULTS:

Describe the results of your research in reference to its original and/or modified Project objectives.

The maximum extension of this section is 5 pages (Arial or Verdana font, size 10).

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The specific aims of project N°1130193 are:

1) Determine the relative amounts of stable and labile C and N in all layers of the Andisol profiles under pristine vegetation and calculate the maximum storage capacity of these soils by:

a. Comparing the SOM saturation of the reactive mineral fraction relative to SOM association in the particle size fraction of clay, silt, sand and POM at each horizon of the soil profile in both, deciduous and evergreen forest soils.

b. Evaluating the degree of metals (Al, Fe) saturation by selective extraction method, synthesis of nanoclay (allophone) and adsorption kinetics of SOM on clay minerals at each horizon of the soil profile in both, deciduous and evergreen forest soils.

2) Identify qualitative (NMR, FTIR, GC) differences in SOM, WEOM, DOM, 14C age from each horizon along a deep soil profile and POM and DOM in stream water of rain forests with contrasting vegetation during two years.

3) Determine the contribution of refractory C pool (black C and N) along the soil horizon in the profile in deciduous and evergreen forest soils.

4) Propose a conceptual model for the mechanism and composition of SOM delivery to and stabilization in the mineral horizons of the pristine temperate rain forest soils under contrasting vegetation.

Results

All aims of this project have been fulfilled. The results from aims 1, 2, 3 and 4 are presented in Annex 1, 2, 3, 4, 5 and 6. All this information has been partially published and other part is in preparation or under review.

We have published or submitted the following papers related to specific aims 1, 2 and 4:

Research papers submitted or published


Review paper published


Paper in preparation


Main Symposium and Congress presentation

1) Merino, C., Godoy, R., Matus. ISMOM 2015. Available carbon for soil microorganisms and soil enzyme in different physical fractions and levels of SOM complexity (poster presentation). “Soil Interfaces For Sustainable Development Conference” (ISMOM 2015), 5-10 July, McGill University, Montreal, Canadá.

2) Merino, C., Palma, G., Fontaine, S., Matus, F. 2015. Effect of aluminium on available carbon from an Andic and Metamorphic temperate rain forest soil. (poster presentation) “Soil Interfaces For Sustainable Development Conference” (ISMOM 2015), 5-10 July, McGill University, Montreal, Canadá.


Dissemination in colloquial presentation

We have already disseminated our work in CONAF and EXPLORA, 1000 científicos 1000 aulas (Annex 11 and 12)
Activities description

All activities 1-20 proposed in the original proposal have been fulfilled. The most relevant activities are described as follows:

Activity A1: Sites selection, experimental design, tension lysimeter installation, soil profile description and soil characterization (fully completed).

Site selection

The present study is conducted in two experimental microcatchments: the first site selected was Lenga dominated by *Nothofagus pumilio* forest type (40°47’S and 72°12’W, 975 m above sea level). The second site was a Coigüe forest dominated by pure evergreen old growth forest of *Nothofagus betuloides* (40°47’2.66”S and 72°14’4.27”W at 957 m above sea level). Both sites present more or less similar mean annual precipitation and temperature (>5,000 mm and 5 °C) whose chemistry still reflects the pre-industrial conditions. The rain forests in southern Chile have not been under chronic air pollution inputs and have remained floristically stable throughout the Holocene/late Pleistocene. At each site four plots of 30 x 30 m were established. In Lenga site (N. pumilio) two opposite faces (east aspect) and (west aspect). In the Coigüe (N. betuloides) site all plots were in the close and far of water stream. The forest vegetation structure at each plot was finely characterized (Annex 6). At each plot a soil pit was excavated. A total of 12 soils pits profiles were fully described and soil samples from each horizon were taken for physical and chemical analysis (Annex 6).

Ceramic suction caps

A total of 12 suction ceramic cap lysimeters of diameter of 5x100 cm (Eijkelkamp) were installed at the end of March 2013. There were re-installed several time as a results of snowing and sliding mad movement in the plots. The lysimeters were installed at the bottom (subsoil) and in the topsoil. All cylinders were left to equilibrate 2 months.

Activity A2 Soil sampling and characterization (fully completed).

Soil sampling was conducted annually using a steal stainless cylinder. All horizons were sampled and characterized (Annex 6).

Activity A3 Water extractable organic matter (WEOM) and dissolved organic matter (DOM) collection and soil characterization (Fully completed)

Water extractable organic matter (WEOM) and dissolved organic matter (DOM) collection and laboratory experiments were fully completed. The experiment consisted in investigate the Al influence on the mineralization of dissolved organic matter (DOM) and thus on carbon (C) sequestration. The research question was why temperate rain forest soils are losing significant amount of DOM compared with northern forests soils? We hypothesize that the mineralization rate upon Al addition to the solution are not affected, because DOM is able to attach Al, leaving bioavailable C for microbial growth or leaching when the molar Al:C ratio < 0.1. Addition of Al to the soil solution beyond a molar Al:C ratio of 0.1, induces precipitation of the organic matter which leads to an excess of Al in the soil solution causing an inhibitory effect for growing microorganisms. We investigated the effect of Al concentrations for the potential of C biodegradation at different Al:C ratios from DOM and Ah mineral soil horizons from two temperate rain forest soils from south of Chile. Dissolved organic matter and surface mineral horizons were incubated with initial molar Al:C ratio from 0.08 to 1.38. Mineralization was quantified by measurement of CO2 evolved during 15 days. Aluminium concentration in DOM and Ah horizons were evaluated by using ATR-FTIR and confocal microscopy, respectively. The results show that increasing initial Al:C ratio > 0.12, led to a considerable reduction in mineralization (up to 70%). For Al:C ratio < 0.12, the mineralization rates from DOM and mineral soils were unaffected. Consequently, there would be a considerable reduction in the biodegradation of DOM and thus an increased in the C sequestration in mineral soils with molar Al:C ratio > 0.12. Although Ah mineral horizons presented a molar Al:C ratio between 0.17±0.001 and 0.27±0.001, the Al treatments had a marked proportional effect at the spectral
ART-FTIR bands assigned to polysaccharide and aromatic compounds. The observed DOM losses in the stream water of pristine southern forests can be explained by increasing the bioavailability of organic C for Al:C ratio < 0.12, since these values in the studied forests fluctuate between 0.08±0.01 and 0.11±0.01.

As part of the Al-SOM characterization we apply for a project in Brazil to see the humus complexes formation in the Synchrotron facilities in Campinas, Brazil. The project title is EFFECT OF ALUMINUM ON AVAILABLE CARBON FOR SOIL MICROFLORA FROM A TEMPERATE RAIN FOREST FLOOR OF VOLCANIC ORIGIN LNLS - Brazilian Synchrotron Light Laboratory, Campinas Brasil. The Proposal founded was SXS-18872. (Annex 13). The results are still analyzing and they will be considered for publication.

Activity A4 Stream water and soil solution collection from the ceramic suction caps (fully completed).

The stream water collection in the suction cups and water stream were completed. The first year we set the methodology and we collect some waters. The second and third years were more complete data set, although not always was possible to collect water, because freezing or drought (Annex 1). For this reason some months are shown as empty entry. The analyses were conducted for inorganic N, organic N and organic C, Ca and Mg losses. We also determined the pH. Full description of methodology were already presented in report N° 2

Activity A5 Physical fractionation of SOM (fully completed)

A fully description is given on paper published in Annex 9.

Activity A6 Adsorption isotherms and synthesis of Al-humus complexes (fully completed)

Al–humic complexes formation was evaluated in an experiment to characterize the impact of different Al concentration on Al-humus complexes formation in the topsoil mineral soils and DOM together with activity 3.

Furthermore we prepare adsorption isotherm in order to see the capacity of the soil to accumulate DOM (Annex 5). The allophane clay mineral was synthetized for adsorption isotherm (data not shown). Finally the results for BC was already presented in report N° 2. Now we are waiting for C analyses to fulfill this activity

General conclusions

Our study has obtained interesting results. We know already the C saturation threshold and why there is so much losses from the stream water by DOM, DON and DIN losses. Our result indicated the existence of a threshold value of metal:C ratio of 0.12, over which Al-humus complexes increases leading a toxicity effect on microbial activity. Under this value, leaching of DOM is possible because Al-humus is not saturated and therefore no precipitated. In this way we were able to evaluate the maximum SOM storage capacity of Andisols under pristine vegetation. Our results have been disseminated in several scientific meetings together with colloquial talks to CONAF which were informed in the second year.
Originalmente estaba invitado el Professor Dr. Buurmman de Wageningen, Holanda, quien por diversas razones no fue posible su presencia para noviembre del 2015, fecha en que se realizó el workshop Internacional organizado por la Universidad de La Frontera. En su reemplazo se trajo al Dr. Raymond Jongschaap, quien es Director de la subdivisión Agrosystem Research del Plant Research International, de la Universidad de Wageningen. Este investigador es experto en modelación matemática en aspectos de fertilidad de suelos y nutrición de plantas. En nuestra Unidad realizó varias exposiciones y participó en las siguientes actividades:

1) Charla expositiva “Yield gap and benchmarks”
2) Comisión de en el examen de calificación de nuestras alumna de Doctorado en Ciencias de Recursos Naturales: Nicole Montalbán
3) 5th International Workshop Advances in Sciences and Technology in Bioresources 2015 realizado 2-4 diciembre en la Ciudad de Pucón.
4) Reunión de trabajo con el IR y su grupo de investigación

La colaboración con el Dr. Jongschaap se inició para colaborar en modelamiento matemático, particularmente en la dinámica de C en suelos volcánicos. El tiene un grupo importante de contactos que nos ayudará a instalar esta línea de trabajo, esencialmente en lo que se refiere a secuestro de C en el suelo. Del mismo modo hemos comenzado a generar datos de emisiones de gases de efecto invernadero, línea de modelamiento que en la unidad de Agrosistemas se desarrolla con gran fuerza:

http://www.wageningenur.nl/nl/Expertises-Dienstverlening/Onderzoeksinstituten/plant-research-international/Over-Plant-Research-International/Organisatie/Agrosysteemkunde.htm

PRODUCTOS

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Dr._Godoy.pdf

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CONGRESOS

Nº: 1
Autor (a)(es/as): Merino C.; Palma, G; Fontaine, S; Matus, F.
Título (Idioma original): Effect of aluminium on available carbon in Andic and Metamorphic temperate rain forest soil
Nombre del Congreso: ISMOM 2015
País: CANADA
Ciudad: Montreal
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2

Merino C.; Matus, F

Available carbon for soil microorganisms, microbial biomass and soil enzyme in different physical fractions and levels of organic matter complexity.

ISMOM 2015

CANADA

Montreal

05/07/2015

10/07/2015

no

ISMOM_20151.pdf


3

M. Panichini and F. Matus

Agricultural management impact on the stabilization of soil organic matter in volcanic soils

4th International Workshop Ufro

CHILE

Pucón

02/12/2013

06/12/2013

Resumen Congreso

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<td>Low nitrate pool in Chilean rainforest volcanic soil: an approach to the abiotic mechanism of nitrogen retention</td>
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Nombre del Congreso: 4th International Workshop Ufro
País: CHILE
Ciudad: Pucon
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N°: 8
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Título (Idioma original): POTENTIAL FOR CARBON SEQUESTRATION IN FINE FRACTION OF CHILEAN TEMPERATE SOILS WITH DIFFERENT MINERALOGY
Nombre del Congreso: Congreso Nacional de la Ciencia del Suelo Punta Arenas – 2014
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TESIS/MEMORIAS

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Nombre y Apellidos del(de la) Tutor(a) :
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