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Dynamics of organic matter in soils formed on limestone and sandstone in the karst area in southwestern China: δ^{13} C and δ^{15} N approaches

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**Dynamics of organic matter in soils formed on limestone

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16**1 Long-bo Li** ^{1,2}, Da-Wei Cai^{1,2}, Xao-Qiang Zhu¹, Ming-Qiang Ren¹
 Long-bo Li ^{1,2}, Da-Wei Cai^{1,2}, Xao-Qiang Zhu¹, Ming-Qiang Ren¹

1 Guizhou Institute of Geo-Environment Monitoring, 171th, Shilinxi Road, **Dynamics of organic matter in soils formed on limestone**
 and sandstone in the karst area in southwestern China:
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1 Guizhou Institute of Geo-Envi **Dynamics of organic matter in soils and sandstone in the karst area in** $S^{13}C$ **and** $\delta^{15}N$ **approaches ong-bo Li^{1,2}, Da-Wei Cai ^{1,*}, Yao-Qiang Zhu¹, Ming-Qiang Ren Guizhou Institute of Geo-Environment Monitoring,**

China

Abstract

To better understand biogeochemical Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046

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To better understand biogeochemical processes associated with the dynamics of soil organic

ter (SOM), the $\delta^{13}C$ Therence of Asian Rock Mechanics Society

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 Abstract

To better understand biogeochemical processes associa

matter (SOM), the δ¹³C and δ¹⁵N values were ana ock Mechanics Society

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tand biogeochemical processes associated with

¹³C and $\delta^{15}N$ values were analyzed in the SOM

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16N values were analyzed in the SOM of limestone soil (developed

16N values were analyzed in the SOM of lim **IOP Publishing**
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To better understand biogeochemical processes associated with the dynamics of soil organic

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To better understand biogeochemical processes associated with the dynamics 161 II Content of Solid Entity and Society

16 Series: Earth and Environmental Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046
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matter (SOM), the $\delta^{13}C$ and $\delta^{15}N$ values were analyzed in

on limestone) and san **ITENTE TO DEVELO** IN the dynamics of soil organic tract To better understand biogeochemical processes associated with the dynamics of soil organic ter (SOM), the $\delta^{13}C$ and $\delta^{15}N$ values were analyzed in the SOM o cs of soil organic

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In addition, the

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M from litter **From 2.6**‰ to 6.3‰ and $\delta^{15}N$ values were analyzed in the S
and there (SOM), the $\delta^{13}C$ and $\delta^{15}N$ values were analyzed in the S
on limestone) and sandstone soil (developed on sandstone), as v
and litter samples iogeochemical processes associated with the dynamics of soil organic d δ^{15} N values were analyzed in the SOM of limestone soil (developed me soil (developed on sandstone), as well as in dominant plant species ed on t **EXECT anterty and Solution** and Societimental processes associate when the SOM of limestone soil on limestone, the SOM of and S¹⁵N values were analyzed in the SOM of limestones oil and sandstone soil (developed on san associated with the dynamics of son organic
zed in the SOM of limestone soil (developed
dstone), as well as in dominant plant species
offiles in karst areas of Southwest China. In
and soil organic nitrogen (SON) is highes 15N values of som originate

15OM of limestone soil (developed

15 swell as in dominant plant species

15 scarst areas of Southwest China. In

15 scarst areas of Southwest China. In

15 scars of soil profiles. In addition thancet (50M), the *δ* C and *δ* ¹ V values were analyzed in the 50M of him
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and litter samples collected on the studied soil profiles in karst acs were analyzed in the SOM of inference sof
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arbon (SOC) and soil organic nitrogen (SON)
downward in both types of soil prof analyzed in the SOM of infersione son (developed
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OC) and soil organic nitrogen (SON) is highest in
d in both types of so

on immation, and sumation on successoir, as were as in continuan punispects on the studied soil profiles in karst areas of Southwest China. In general, the content of soil organic carbon (SOC) and soil organic introgen (S 13_C and δ^{15} N with a decrease in the SOM content in the yellow sandstone soil significantly ince samples concected on the studied on the polonical states of Social organic carbon (SOC) and soil organic introgen (SON) is highest in trace soil layer and decreases downward in both types of soil profiles. In additi genera, un content of sori or sori or game curron (boot) and sori or game mutogen (boot), is magnet in both types of soil profiles. In addition, the content of SOM (including both SOC and SON) in the limestone is much hig or (501v) is ingnest in
ofiles. In addition, the
much higher than in
magnesium, and clay
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soil $\delta^{13}C$ values range
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ractions δ^{15} N, which can be mainly attributed to land-use changes and organic and mineral interactions onces on the mainlang board soc and social non-the maission is under the significant and minerals, are probably the reasons for the higher SOM content in the limestone soil compared to the sOM of the upper layers of yell sandstone son: The inglier pri variates, as were as the ex-
minerals, are probably the reasons for the higher SOM of
the sandstone soil.
In the SOM of the upper layers of yellow sandstor
from 2.6‰ to 6.3‰ and $\delta^{15}N$ va an sansono son.
In the SOM of the upper layers of yellow sandstone and limestone soil $\delta^{13}C$ values range
from 2.6‰ to 6.3‰ and $\delta^{15}N$ values from 5.1‰ to 8.1‰, which is larger than in litters. Yellow
sandstone soil sandstone soils have smaller differences bet
topsoil than the limestone soil. The $\delta^{13}C$ and
sandstone soil profiles, but not in the limest
and $\delta^{15}N$ with a decrease in the SOM c
substantiates the decomposition of differential ecosystems are almost three times grader than the storage of $\delta^{12}C$
 $\delta^{15}N$ with a decrease in the SOM content in the yellow sandstone soil significantly
stantiates the decomposition of SOM, which causes and $\partial^{15}N$ with a decrease in the SOM content in the yellow sandstone soil significantly
substantiates the decomposition of SOM, which causes higher values of $\partial^{13}C$ and $\partial^{15}N$ values in
the deeper soil horizons.

substantiates the decomposition of SOM, which causes higher values of $\delta^{13}C$ and $\delta^{15}N$ values in the deeper soil horizons. By contrast, the limestone soil has complex depth profiles of $\delta^{13}C$ and $\delta^{15}N$, whic the deeper soil horizons. By contrast, the limestone soil has complex depth profiles of $\delta^{13}C$ and $\delta^{15}N$, which can be mainly attributed to land-use changes and organic and mineral interactions between soil accumul $\partial^{15}N$, which can be mainly attributed to land-use changes and organic and mineral interactions
between soil accumulations.
Keywords: Soil organic matter, carbon isotope; nitrogen isotope; karst area; China
1 **Introd** between soil accumulations.
 Keywords: Soil organic matter; carbon isotope; nitrogen isotope; karst area; China

1 **Introduction**

The world's soils are an integral part of the global carbon (C) cycle and as a source of
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 I Introduction
 I'me world's soils are an integral part of the global carbon (C) cycle and as a source of

atmospheric CO₂ can release a large amount of C into the atmosphere every year [1] **Keywords:** Soil organic matter; carbon isotope; nitrogen isotope; karst area; China

1 **Introduction**

The world's soils are an integral part of the global carbon (C) cycle and as a source of

atmospheric CO_C can relea production and quality, and maintaining water quality [6]. Therefore, a better understanding of **1 Introduction**
The world's soils are an integral part of the global carbon (C) cycle and as a source of
atmospheric CO₂ can release a large amount of C into the atmosphere every year [1]. SOC stocks
in terrestrial eco Fine world's soils are an integral part of the global carbon (C) cycle and as a source of atmospheric CO₂ can release a large amount of C into the atmosphere every year [1]. SOC stocks in terrestrial ecosystems are almo The world's soils are an integral part of the global carbon (C) cycle and as a source of ospheric CO₂ can release a large amount of C into the atmosphere every year [1]. SOC stocks errestrial ecosystems are almost three The world is a solute of the magnetic CO₂ carbon and on the store carbon (\sim) vere and as solute of C interestrial ecosystems are almost three times greater than the storage of C in vegetation [2] and twice as large a annospheric Cozan rictane a range amodom of C mio un amuspheric very year [11]. Osco societies alter the storage of C [3]. Due to the large amount stored in terrestrial ecosystems, a small change in SOC significantly affec in cristiant costsystems are aimost unter times gicale unit in the subtropic areas and twice as large as the global atmospheric istorage of C [3]. Due to the large amount stored in terrestrial ecosystems, a small change in and twice as large as un espointance solonge of C₁). Due to the lage annotation of greenhouse gases in the atmosphere. Accordingly, concerns about global varming are increasing interest in quantifying the control of soil

eries and the more allots are allots and the combined with the since the contention of specific members are combined in the combined in the since of SOC is of growing concern as it is important for improving soil quality, giventouse sass in the numerator. Accounting, volverial and given when the meaning are inclusively and production and given and storage [4], [5]. Meanwhile, the issue of SOC is of growing concern as it is important for imp

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With the continuation of rocky desertification, soils in karst areas undergo degradation, which
leads to chemic leads to chemical and physical (decomposition and erosion) loss of SOM. Therefore, to protect and physical (decomposition and erosion) loss of SOM. Therefore, to protect soil quality, a better understanding of how SOM is d **Society IOP Publishing**
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With the continuation of rocky desertification, soils in karst

leads to chemical and physical (decomposition and erosi

The stable isotopic composition of C is widely used to study biographs and the stochemical and physical (decomposition and erosion) loss of SOM. Therefore, to protect to composition of rocky desertification, soils in karst **IOP Publishing**

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With the continuation of rocky desertification, soils in karst areas undergo degradation, **IOP Publishing**

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With the continuation of rocky desertification, soils in karst areas undergo degradation 167. If the continuous Society

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With the continuation of rocky desertification, soils in karst areas unde 16The fraction of Asian Rock Mechanics Society

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With the continuation of rocky desertification, soils in karst areas unde ICPT TO THOUT THE STATE STATE STATE OF A COLOCITY CONTINUES TO THOUT THOUT A CONSENSIBLE STATE AND THOUT INTO THOUT INTO A CONSENSIBLE STATE AND INTO THOUT INTO THOUT INTO THOUT INTO THOUT A UNIT A Delay to chemical and ph is section and Environmental section of $[2021]$ 0020+0

With the continuation of rocky desertification, soils in karst areas undergo degradation, which

leads to chemical and physical (decomposition and erosion) loss of In the continuation of rocky desertification, soils in karst areas undergo degradation, which
Is to chemical and physical (decomposition and erosion) loss of SOM. Therefore, to protect
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the distribution of relationships of SOM. Therefore, to protect
soil quality, a better understanding of how SOM is decomposed and lost during land degradation
in the karst area is need variations in physical decomposition and costor) isses of some Their ore, to protect
soil quality, a better understanding of how SOM is decomposed and lost during land degradation
in the karst area is needed.
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20. methods of dual stable plant of N rms of N uptake by plant N cycles [24], [25], [26 one, to protect
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son yuanty, a occur uncessant and soil and sandstone of C is widely used to study biogeochemical processes in soils [10], [11], [12] and to assess the degree of decomposition of SOM [13], [14], [15]. The natural amount of in the stand is nected.

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soils [10], [11], [12] and to assess the degree of decomposition of SOM [13], [14], [15]. The

natural amount of ¹⁵N is used to access the loss of nitrogen (N) and the na ady biogeochemical processes in
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ms of N uptake by plant
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methods of dual stable
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ncocks and sandstones in
study, we investigated
³C and $\delta^{15}N$ values in
a and sand solone solone of Southwest China, the study is a study of the matter allows the factors controlling in the same space. In the same space of decomposition of SOM [13], [14], [15]. The natural amount of ¹⁵N is us sons [10], [11], [12] and to assess the tagted of accordinatural amount of ¹⁵N is used to access the loss mineralization [16], [17], [18], [19], [20], [21], [22] to species [23], as well as to determine the impact of la E_1 and *δ* assess the degree of decomposition is 1^{5} N is used to access the loss of nitroge $\{1^{7}\}$, $\{18\}$, $\{19\}$, $\{20\}$, $\{21\}$, $\{22\}$ to compare the ll as to determine the impact of land-use histo 15N values in different soils, and, finally, to achieve a better of N (50M place at to access the loss of nitrogen (N) and the nature of N (19), [20], [21], [22] to compare the patterns of N uptake by plant ermine the imp mana amount or As a sect to excess on timogen (18). [19], [19], [19], [19], [20], [21], [12] to compare the patterns of N uptake by plant species [23], as well as to determine the impact of land-use history on N cycles [2 Accordingly, in recent decades, many researchers have wide
isotopes (both ¹³C and ¹⁵N) to study the dynamics of SOM [2
There are two main types of soils formed respectively of
the karst area in the Guizhou Province of There are two main types of soils formed respect
the karst area in the Guizhou Province of Southw
variations in SOC and SON content, as well as va
limestone soil and sandstone soil. The main object
content of SOC and SON, Example 10. The uncourance of solutions in their $\delta^{12}C$ and $\delta^{15}N$ values in a strain in SoC and SON content, as well as variations in their $\delta^{12}C$ and $\delta^{15}N$ values in store soil and sandstone soil. The main Variations in 30 comand 30 km, respectively, from Guiyang City (26°28′ 19″ N, values of their study are to characterize the content of SOC and SON, as well as to study the factors controlling variations in the content of

muson and samatome sori. The man voluceurs or thus study are to character of GOC and SON, as well as to study the factors controlling variations in the content of SOC, SON, and their $\delta^{13}C$ and $\delta^{15}N$ values in diff concinent of Sec 2 and solid is the usual of the factors controlling variations in the content of SOC,
soN, and their $\delta^{12}C$ and $\delta^{15}N$ values in different soils, and, finally, to achieve a better
understanding the annual samesons sois, as were as to satury in cattors controlling variations in inc content of 50-C, and their $\delta^{15}C$ and $\delta^{15}N$ values in different soils, and, finally, to achieve a better understanding the dynamic **2.1 Study site**

anderstanding the dynamics of SOM and soil formation processes in karst areas.
 2.1 Study site
 2.1 Study site

The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, abou 2. **Study site** inducts and methods and solution processes in Karst areas.

2. **I Study site**

The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, about

15 and 30 km, respectively, from Gui 2 Materials and methods

2.1 Study site

The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, about

15 and 30 km, respectively, from Guiyang City (26°28' 19" N, 106°49' 18" E), the central r **2.1 Study site**
 2.1 Study site
 **1.5 and 30 km, respectively, from Guiyang City (26°28' 19" N, 106°49' 18" E), the central region

of Guizbou Province, China (Fig. 1), at an altitude of about 1300 m above sea level. T 2.1 Study site**

The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, about

15 and 30 km, respectively, from Guiyang City (26°28' 19" N, 106°49' 18" E), the central region

of Guizhou Provi **2.1 study sire**
The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, about
15 and 30 km, respectively, from Guiyang City (26°28′ 19″ N, 106°49′ 18″ E), the central region
of Guizhou Province The investigated sites are located in Baiyi of Wudang and Wangjiazhai of Qingzhen, about 15 and 30 km, respectively, from Guiyang City (26°28' 19" N, 106°49' 18" E), the central region of Guizhou Province, China (Fig. 1), IS and 30 km, respectively, from Guiyang City ($26^{\circ}28^{\circ}19''$ N, $106^{\circ}49^{\circ}18''$ E), the central region of Guizhou Province, China (Fig. 1), at an altitude of about 1300 m above sea level. The central region of Guiz Examples of Guizhou Province, China (Fig. 1), at an altitude of about 1300 m above sea level. The central region of Guizhou Province, thina (Fig. 1), at an altitude of about 1300 m above sea level. The central region of G or contant rowtwee, cannot (raj. 1), and and matco or about 1:000 in accove sat ever. In econtant energion of Guizhou Province has a subtropical, monsoon, and humid climate, with an average annual temperature of 14.8 °C an

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onference of Asian Rock Mechanics Society
 2.2 Soil sampling and laboratory analysis
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The litter horizons were removed before soi The litter horizons were removed before soil sampling. Soil samples were taken from the soil sampling and laboratory analysis

Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. S Series: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046

2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. Soil samples were taken from of Series: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046

2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. Soil samples were taken fr Society

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 2.2 Soil sampling and laboratory analysis

The litter horizons were removed before **Example 10** molecomorpoon Monecomorpoon Scottis 10 multiple solution was added to the solution 10P Publishing
16. Series: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046
2.2 Soil sampling and laboratory analysis
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2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. Soil sa 100P Publishing

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2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampli nt. Series: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1/55-1315/861/6/062046

2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. Soil samples were taken f 2.2 Soil sampling and laboratory analysis

The litter horizons were removed before soil sampling. S

surface (0–5 cm depth), followed by sampling from the pit v

of about 100 cm in the lower horizon. Visible roots and c
 Soli sampling and laboratory analysis
The litter horizons were removed before soil sampling. Soil samples were taken from the soil
ace (0–5 cm depth), followed by sampling from the pit walls from a depth of 5 cm to a de The litter horizons were removed before soil sampling. Soil samples were taken from the soil surface (0–5 cm depth), followed by sampling from the pit walls from a depth of sont o a depth of about 100 cm in the lower hori surface (0-5 cm depth), followed by sampling from the pit valls from a cleaned not not an experimental of the about 100 cm in the lower horizon. Visible roots and organic debris were removed during sampling. Soil samples sumed (ν) cm acquit, whower by sampling not me put wans not an expirion to 3 capin and the solid ampling. Soil samples containing about 1–2 mg of SOC were placed in 15 mL centrifuge tubes, and tubes without soil were u notative of the soil was measured using a pH electrode using the solid without soil amples ontaining about $1-2$ mg of SOC were placed in 15 mL centrifuge tubes, tubes without soil were used as controls; 10 mL of 2 mol L sampling. Our samples ocnaining about -2 ing or 50 soil water paracel parallel by the supernatant was discarded, and then 10 mL of 0.1 mol L⁻¹ KCl solution was added to the test tubes and shaken for 1 hour at 25 °C, a and those wholone uses as solution, to unce of the centrifuged at 3000 r min⁻¹ for 25 min, the supermatant was discarded, and then 10 mL of 0.1 mol L⁻¹ HCl solution was added to the tubes and shaken for 24 hours at 25 For the analysis of stable in the analysis of the amount of \sim 2 mm, when the analysis of the analysis of the analysis of the analysis of the analysis [31]. Before taking soil samples, litter was collected on an area of

solution that sustantice, and then the small of the sample tube was evacuated to the discondination of the samples, but the samples, litter was collected on an area of 4 m² for each profile. Samples of fresh foliage wer and shaced to \approx - coals at \geq c and dot elementaged at 5000 \cdot limit for \geq min, washed and metallibuted to the samples, liter vas collected on an area of 4 m² for each profile. Samples of fresh foliage were butual with visitive wate, centringied and tried at ob \sim , then ground and kept for \sim that is
isotopic analysis [31]. Before taking soil samples, litter was collected on an area of 4 m² for each profile. Samples
of Examples of reach profile. Samples, litter was collected on an area of 4 m² for each profile. Samples of fresh foliage were also taken from the dominant tree, shrub, and grass species of each major vegetation type. Fres Example of resolution and the momentum of the Internation of the stable containing solution type. Fresh foliage samples were cleaned with distilled water, and litter samples, separated from any adhering oil material, were or using two uses wave in our denominant tee, since, with giass spectros or user in any expectation type. Fresh foliage samples were cleaned with distilled water, and litter samples, separated from any adhering oil materi expectant yer. Then ionted variance with using the Signapholian of the Internal Analytical accuracy, and method for the pH value of the soil was measured using a pH electrode (Orion) in a ratio of 1:2.5 (m/v) soil to deio spenare noni any analong on national, we concerator or can finely grounocal.
The pH value of the soil was measured using a pH electrode (Orion) in a ratio of 1:2.5 (m/v)
soil to deionized water. The content of organic C of 1:2.5 (m/v)
mbustion in an
laced in a quartz
The organic C in
nd cryogenically
the manometric
ass spectrometric
f 252 gas isotope
es in SON were
eviation obtained
 $e^{13}C = -24.97\%$,
 $e^{13}C = -24.97\%$,
 $e^{13}C = -24.97\%$ The pri vante of the son was ineasticed using a pri electrote (Orion) in a rasoil to deionized water. The content of organic C and N was analyzed by elemental Analyzer (PE2400 II, USA) with an analytical accuracy of 0.1%. at using a pri ciclude (soloni) in a fatto of 1.2.5 (nv)
organic C and N was analyzed by combustion in an
than analytical accuracy of 0.1%.
sample of mass giving 0.5 mg C was placed in a quartz
was evacuated and sealed wi Som to denote wate. The content of vigance C and Y was standard (MOR2386-01, 192‰) provided by Shoko Co., Ltd. (Tokyo, Japan),
Blemental Analyzer (PE2400 II, USA) with an analytical accuracy of 0.1%. For the ample was oxi External Analyzer (1 Ez-too ii, OSA) with an analytical acce-

For the analysis of stable isotopes, a sample of mass give

tube with CuO, and then the sample tube was evacuated and

the sample was oxidized to CO₂ at 85 2.400 II, O.3A) with an analytical accuracy of 0.176.

table isotopes, a sample of mass giving 0.5 mg C was placed in a qua

the sample tube was evacuated and sealed with a flame. The organic C

d to CO₂ at 850 °C for 5 For an analysis of station the sample the was expressed by the angle of mass giving 0.5 and the sample was oxidized to CO₂ at 850 °C for 5 hours. CO₂ was collected and cryfied in a vacuum extraction line, while the am at 850 °C for 5 hours. CO₂ was collected and cryogenically
 δ at 850 °C for 5 hours. CO₂ was collected and cryogenically
 *i*e, while the amount of CO₂ was measured by the manometric
 *i*es (³C/⁷²C) were mea where *δ*x is the ratio of Cor N isotopes in delta units relative to international standards (Pee Deemenite for C and standards), The C or N isotoperation ince, while the amount of CO₂ was measured by the manometric ana punctor a vacuator lane, wme the amount of Coz^o was measured by the immediate obtering collected in a test tube with a burst seal for subsequent mass spectrometric analysis [32]. Stable C isotope ratios (¹³C/¹³C) we meano to come or samples and standards spectromer and standard coochemistry of the Chinese Academy of Sciences.
Beauty analysis [32]. Stable C isotope ratios (¹³C/¹²C) were measured on a Finnigan MAT 252 gas isotope m amaysis [25]; statore Using the purification with liquid introgen. The intergen isotopes in SON were
measured by the Xiao method [31]. Analytical accuracy, defined as the standard deviation obtained
over 35 replicates of over 35 replicates of the IAEA C3 laborat
cellulose) was used as the standard for $\delta^{13}C$
the potassium nitrate standard (MOR2386-01
gave the mean (± S.D.) $\delta^{15}N_{air}$ value 1.9 ± 0.2
Isotope signatures are expressed b

the potassium nitrate standard (MOR2386-01, 1.92%) and
gave the mean (\pm S.D.) δ^{15} N_{air} value 1.9 \pm 0.2% ($n = 5$).
Isotope signatures are expressed by delta notation:
 δx ($\%$) = 1000(R_{samp})
where δx The mean (\pm 3.12.7) or V_{asym} value 1.2.3 to $(1 - 2)$.

Sotope signatures are expressed by delta notation:
 δx (%o) =1000(R_{sample} and R_{standard} are to international standards (Pee Dee

mmite for C and atmosphe solope signatures are expressed by α correlations of α (α) and R_{sample} and R_{sample} where δx is the ratio of C or N isotopes in delta units relative to international standards (Pee Dee
Belemnite for C and atmospheric N₂ for N) and R_{sample} and R_{samdard} are the ¹³C/¹²C or ¹⁵N/¹⁴N ratios
fo

increase of Asian Rock Mechanics Society IOP Publishing
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increase with depth, while the soil pH values of the sand for Publishing

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increase with depth, while the soil pH values of the sandstone soil profiles change in different

ways: the 1.6 for the BY-I soil profile first decrease to a depth of 30 cm and then increase from pH = 4.0 to pH = 4.7 in the lower part of the profile.

4.6 cm $\frac{P}{2}$ soil profile first decrease to a depth of 30 cm and then inc freme of Asian Rock Mechanics Society

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increase with depth, while the soil pH values of the sandstone soil p

ways: the pH values remain nearly constant al

EXECUTE SOLUTE ANTIFY AND SOLUTE AREAD AREAD SOLUTE AND AREAD ASSOC AND AREAD ASSOC USING A SHOWN IN FIG. 30, SOC usually decreases with depth and is significantly higher in alimestone soil than in yellow sandstone soil. Profiles, with the largest accumulations of SOC and SON occurring in the largest accumulations of SOC and SON occurring in the profiles of the last solution south that in yellow sandstones of SOC and SON occurring in the Solution. The solution of the soil of profile of profile of profile of profiles and interval and intervals of t **Example 100**
 \leftarrow **a** = 02.41
 \leftarrow 02.41
 \leftarrow 02.41
 Fig. 2. Depth profiles of pH values in the studied soils.
 3.2 Carbon and nitrogen content in the soil

As shown in Fig. 3a, SOC usually decreases with dept SOC Content (69.8 g kg⁻¹ at the surface, while for yellow sandstone soils, the soil and introduced soils.
SOC content in the soil and introduced solid as significantly higher in limestone soil than in yellow sandstone **Example 19.8** Fig. 2. Depth profiles of pH values in the studied soils.

3.2 Carbon and nitrogen content in the soil

As shown in Fig. 3a, SOC usually decreases with depth and is significantly higher in

limestone soil 170

Fig. 2. Depth profiles of pH values in the studied soils.

3.2 Carbon and nitrogen content in the soil

limestone soil than in yellow sandstone soil SOC and SON are uneverly distributed over soil

limestone soil tha Fig. 2. Depth profiles of pH values in the studied soils.
 Carbon and nitrogen content in the soil

As shown in Fig. 3a, SOC usually decreases with depth and is significantly higher in

stestone soil than in yellow sand 3.2 Carbon and nitrogen content in the soil
As shown in Fig. 3a, SOC usually decreases with depth and is significantly higher in
limestone soil than in yellow sandstone soil. SOC and SON are unevenly distributed over soil **S.2 Carbon and nitrogen content in the soil**
As shown in Fig. 3a, SOC usually decreases with depth and is significantly higher in
limestone soil than in yellow sandstone soil. SOC and SON are unevenly distributed over so As shown in Fig. 3a, SOC usually decreases with depth and is significantly higher in
limestone soil than in yellow sandstone soil. SOC and SON are unevenly distributed over soil
profiles, with the largest accumulations of Finestone soil and Novella and Solution of SOC and SON are unevenly distributed over soil then in rigs. 3n, 50C ustary uccesses with celuminary match in profiles, with the largest accumulations of SOC and SON occurring in measone sort man in yearned over all other specifies, with the largest accumulations of SOC and SON occurring in the upper 20 cm of the soil horizon. Surface soils of profile QZ-II (yellow sandstone soil) show the lowest

Fig. 4. Depth profiles of the mass ratios of organic carbon and nitrogen (C/N) in the
studied soils.
As shown in Fig. 4, the mass ratio of organic carbon and nitrogen (C/N) in the
studied soils.
As shown in Fig. 4, the ma

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Soil profiles display a range of C/N mass ratios from 6 to 15 and a range of C/N mass ratios from
2 to 10 at a depth of 60 cm, which shows an overall decrease from the top to the depth of to 10.1088/1755-1315/861/6/062046
16. Series: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046
16. So 16 profiles. Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1315/861/6/062046

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16. Soil profiles displa soil. nce of Asian Rock Mechanics Society

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10 at a depth of 60 cm, which shows an overall decreas

10 at a depth of 60 cm, which shows an overall decreas

13**C** values of

3.3 δ^{13} C values of SOC

The yellow sandstone soils show different depth profiles of *δ***¹³Csoc from linestian and the solution of** *S***¹³Cs of** *CN* **mass ratios from 6 to 15 and a range of** *CN* **mass ratios from 10 at a depth of 60 cm, which sho** 13Csoc from limestone soil
13Csoc from the top to the depth of the
imestone soil and sandstone
13Csoc from limestone soil
14Csoc from limestone soil
14epth of about 20 cm, and
16the latter shows an overall
1 then a decrea profiles: Earth and Environmental Science 861 (2021) 062046 doi:10.1088/1755-1
soil profiles display a range of C/N mass ratios from 6 to 15 and a range of C/N mass ra
2 to 10 at a depth of 60 cm, which shows an overall 13Coc from the same of C/N mass ratios from

13Coc from 6 to 15 and a range of C/N mass ratios from

13Coc from the top to the depth of the

13Coc from the top to a depth of about 20 cm, and

13Coc from top to a depth of 16Thence of Asian Rock Mechanics Society

16Then maintains: Earth and Environmental Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046

soil profiles display a range of C/N mass ratios from 6 to 15 and a range If. Series: Earth and Environmental Science **861** (20

soil profiles display a range of C/N mass ratios from

2 to 10 at a depth of 60 cm, which shows an overa

profile. There is no clear difference between the ma

soil. th and Environmental Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046
display a range of C/N mass ratios from 6 to 15 and a range of C/N mass ratios from
depth of 60 cm, which shows an overall decrease from soil profiles display a range of C/N mass ratios from 6 to 15 and a range of C/N mass ratios from
2 to 10 at a depth of 60 cm, which shows an overall decrease from the top to the depth of the
profile. There is no clear d soil profiles display a range of C/N mass ratios from 6 to 15 and a range of C/N mass ratios from
2 to 10 at a depth of 60 cm, which shows an overall decrease from the top to the depth of the
profile. There is no clear di 2 to 10 at a depth of 60 cm, which shows an overall decrease from the top
profile. There is no clear difference between the mass C/N ratios of limeston
soil.
3.3 δ¹³C values of SOC
The yellow sandstone soils show dif hows an overall decrease from the top to the depth of the
tween the mass C/N ratios of limestone soil and sandstone
values at the mass C/N ratios of limestone soil and sandstone
oriences at $\delta^{13}C_{SOC}$ from top to a dep profile. There is no clear difference between the mass C/N ratios of limestone soil and sandstone
soil.
3.3 δ^{13} C values of SOC
The yellow sandstone soils show different depth profiles of δ^{13} Csoc from limestone s sandstone soil profiles. The difference between the maximum and minimum $\delta^{13}C_{\text{SOC}}$ values Soil.

3.3 $\delta^{13}C$ values of SOC

The yellow sandstone soils show different depth profiles of $\delta^{13}C_{SOC}$ from limestone soil

profiles: the former shows a rapid increase in $\delta^{13}C_{SOC}$ from top to a depth of abou 3.3 $\delta^{13}C$ values of SOC

The yellow sandstone soils show different depth profiles of $\delta^{13}C_{SOC}$ from limestone soil

profiles: the former shows a rapid increase in $\delta^{13}C_{SOC}$ from top to a depth of about 20 cm, **3.3 δ¹C Values of SOC**

The yellow sandstone soils show different depth profiles of δ¹³C_{SOC} from limestone soil

profiles: the former shows a rapid increase in δ¹³C_{SOC} from top to a depth of about 20 cm, and
 difference (5.5%) between the maximum and minimum $\delta^{13}C_{\text{SOC}}$ values.

[33]. **120**
 130
 130
 13 15NSON values increase from about +2.9‰ in the surface layer of the soil to about the soil at a depth of about 20 cm. Stating from a depth of 20 cm and below, the soil at a depth of about 20 cm. Stating from a depth of 20 120 **i CD i CD i c c i c i c c c c i c i c c c i c i c i c c i c i c i c c i c i c c i c i c c i c i c c i c i c**

3.4 δ ¹⁵N values of SON

Ference of Asian Rock Mechanics Society

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profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles

and yellow limestone sho 15N_{SON} values, while the profiles of yellow sandstone
¹⁵N_{SON} values, while the profiles of yellow sandstone
tues decrease with depth. In addition, at a depth of 20
1911 of the profile. Exeries: Earth and Environmental Science 861 (2021) 062046 doi:1

profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the protide 150 Society

1618 Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046

1615 Constant δ^{15} Nson values, while the profiles of yellow sandstone

1515 Son values decrease with depth. In addition, at a depth of Exercise of Asian Rock Mechanics Society

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profiles of black limestone show constant $\delta^{15}N_{SON}$ va

and yellow limestone show that $\delta^{15}N_{SON}$ values decre

to 60 cm, 15N values for leaves of dominant plants and the litters of δ^{15} N measured for the leaves of dominant plants and differ greatly depending on the solution, at a depth of 20

15N values change a lot and differ greatly d **13C** and *δ*¹⁵**N comparision** *Contenting Society*
143C and *Environmental Science 861 (202)*
143 and *δ*¹⁵**N** values change a lot and differ gree cm, the δ^{15} N values change a lot and differ gree
1 ¹⁵N values for leaves of dominant plants and the litters

3.5 δ^{13} C and δ^{15} N values for leaves of dominant plants and the litters

nce of Asian Rock Mechanics Society
ries: Earth and Environmental Science **861** (2021) 0620
files of black limestone show constant $\delta^{15}N_{SON}$ values,
yellow limestone show that $\delta^{15}N_{SON}$ values decrease w
0 cm, the Example 12 External Science 861 (2021) 062046

13C and *S* invironmental Science 861 (2021) 062046

13C and *δ*¹⁵Nson values decrease with depth

13C and *δ*¹⁵N measured for the leaves of dom

13C and *δ*¹⁵N measure 1618 Society

1619 Publishing

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2619 M_{SON} values, while the profiles of yellow sandstone

261⁵¹N_{SON} values decrease with depth. In addition, at a depth of 20

1620 and differ greatly Society

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profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles of yellow sandstone ference of Asian Rock Mechanics Society

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profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles of yel

and yellow 10P Publishing

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¹Son values, while the profiles of yellow sandstone

s decrease with depth. In addition, at a depth of 20

er greatly depending on the soil profile.
 ant plants and the litters

or the Ference of Asian Rock Mechanics Society

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profiles of black limestone show constant $\delta^{15}N_{SON}$ values, while the profil

and yellow limestone show tha 13C is the 12C values and the profiles ranging from $-1.088/1755-1315/861/6/062046$

stant δ^{15} Nsox values, while the profiles of yellow sandstone

sox values decrease with depth. In addition, at a depth of 20

t and Series: Earth and Environmental Science **861** (2
profiles of black limestone show constant $\delta^{15}N_{SO}$
and yellow limestone show that $\delta^{15}N_{SO}$ values d
to 60 cm, the $\delta^{15}N$ values change a lot and differ β
3. arth and Environmental Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046

black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles of yellow sandstone

v limestone show that $\delta^{15}N_{SON}$ valu profiles of black limestone show constant δ^{15} Ns_{0N} values, while the profiles of yellow sandstone
and yellow limestone show that δ^{15} Ns_{0N} values decrease with depth. In addition, at a depth of 20
to 60 cm, th files of black limestone show constant $\delta^{15}N_{SON}$ values, while the profiles yellow limestone show that $\delta^{15}N_{SON}$ values decrease with depth. In addi 0 cm, the $\delta^{15}N$ values change a lot and differ greatly depe tant δ¹³N_{SON} values, while the profiles of yellow sandstone

con values decrease with depth. In addition, at a depth of 20

and differ greatly depending on the soil profile.
 of dominant plants and the litters

as and yellow limestone show that $\delta^{15}N_{SON}$ values decrease with depth. In addition, at a depth of 20
to 60 cm, the $\delta^{15}N$ values change a lot and differ greatly depending on the soil profile.
3.5 $\delta^{13}C$ and δ^{15 to 60 cm, the $\delta^{15}N$ values change a lot and differ greatly depending on the soil profile.

3.5 $\delta^{13}C$ and $\delta^{15}N$ values for leaves of dominant plants and the litters

The values of $\delta^{13}C$ and $\delta^{15}N$ measur 15 δ¹³C and δ¹⁵N values for leaves of dominant plants and the litters

The values of δ¹³C and δ¹⁵N measured for the leaves of dominant plant species and litter

amples collected from different soil profiles are 5.5 σ ^{3.}C and σ ^{2.}N values for reaves or dominant plants and the inters

The values of $\delta^{13}C$ and $\delta^{15}N$ measured for the leaves of dominant plant species and litter

samples collected from different soil The values of $\delta^{13}C$ and $\delta^{15}N$ measured for the leaves of dominant plant species and litter
samples collected from different soil profiles are shown in Table 2. The leaves of dominant
plants grown on yellow sandsto

 δ^{15} N measured for corresponding litter samples are -2.2‰ and -2.3‰ for yellow sandstone soil The values of *δ*¹ C and *δ*¹ N inclusion of the feaves of as
les collected from different soil profiles are shown in Ta
grown on yellow sandstone soil have $\delta^{13}C$ values ranging from -3
of $\delta^{15}N$ measured for lifferent soil profiles are shown in Table 2.

andstone soil have $\delta^{13}C$ values ranging from -

soil have $\delta^{13}C$ values ranging from -30.0% to

or the plant leaves in yellow sandstone soil pro

eaves in limestone s measured rot in textes of dominant pairs postes and interaction
soil profiles are shown in Table 2. The leaves of dominant
soil have $\delta^{13}C$ values ranging from -29.6% to -27.4%, and
 $\delta^{13}C$ values ranging from -30.0% Litter samples have values of $\delta^{13}C$ -28.2‰ and -27.1%
profiles BY-I and QZ-III, respectively, and -27.3‰, -27.8‰, soil profile BY-II and black limestone soil profiles QZ-I and $\delta^{15}N$ measured for corresponding litt Now sandstone soil
or yellow limestone
vely. The values of
llow sandstone soil
ellow limestone soil
and topsoil SOM.
 $\delta^{15}N$ value
opsoil SOM of
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 4 Discussion
 4.1 Lithological control of SOM in soils
 Heckman et al [4] recently conducted is

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 4.1 Lithological control of SOM in soils

Heckman et al [4] recently conducted a systematic study of ge IOP Publishing
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iscussion

Lithological control of SOM in soils

Heckman et al [4] recently conducted a systematic study of geolo cycling and microbial dynamics Society

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4 Discussion

4.1 Lithological control of SOM in soils

Heckman et al [4] recently c IOP Publishing
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4 Discussion
4.1 Lithological control of SOM in soils
Heckman et al [4] recently conducted a systematic study They concluded that the change in the mechanism of carbon stabilization concluded that the change in the change in the mechanism of cycling and microbial dynamics in temperate conferous forests and demonstrated that the cy **IOP Publishing**
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 4.1 Lithological control of SOM in soils
 4.1 Lithological control of SOM in soils
 4.1 Lithologic nterence or Asian Kock Mechanics Society
 4.1 Lithological control of SOM in soils
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4.1 Lithological control of SOM in soils

Heckman et al [4] recently conducted a systematic study of geological control of so **4 Discussion**
 4.1 Lithological control of SOM in soils

Heckman et al [4] recently conducted a systematic study of geological control of soil C

eycling and microbiol dynamics in temperate conierous forests and demons **4.1 Lithological control of SOM in soils**

Heckman et al [4] recently conducted a systematic study of geological control of soil C

cycling and microbial dynamics in temperate coniferous forests and demonstrated that the

values.

Example 1. For example, at higher soil pH, Fe is less soluble, and sorption reaction of metal-humus complexes [37]. High pH values of bearing the metal of the contraction of mother complexes in soil pH values.

Fig. 6. Ch **Example 1.1** 1.0
 Example 1.1 1.0
 Example 1.0
 Example 1.1
 Example 1.1
 Example 1.1
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 Example 1.1
 Ex For the metal-human complexes [37]. High pH values of metals due to the sources of methal, which can stabilize SOC due to the formation of acaditing soil and the personal state of the metal-humus complexes [37]. High pH v the preservation of mobile cations and traces of metals due to the sorption of minerals, which Soul pH value

Soul pH value

Soul pH can be an important comprehensive control of SOC dynamics, although there is no

solid pH can be an important comprehensive control of SOC dynamics, although there is no

direct correl Fig. 6. Changes in soil organic carbon (SOC) and soil organic nitrogen (SON) content with soil pH
values.
Soil pH can be an important comprehensive control of SOC dynamics, although there is no
direct correlation between p Fig. o. Changes in son organic caroon (SOC) and son organic imaged; (SOC) conclusion with son pri-
values.
Soil pH can be an important comprehensive control of SOC dynamics, although there is no
direct correlation between Soil pH can be an important comprehensive control of SOC dynamics, although there is no
direct correlation between pH and SOC [4]. Soil pH can play an important role in affecting SOM
by controlling mineral and microbial va Soil pH can be an important comprehensive control of SOC dynamics, although there is no
et correlation between pH and SOC [4]. Soil pH can play an important role in affecting SOM
controlling mineral and microbial variables our part and magnesium are lost through leading from to soo contents, antology unce to so the direct correlation between pH and SOC [4]. Soil pH can play an important role in affecting SOM by controlling mineral and microb muculation occurre privation conter and occurs. The marking solution and the contention content of clay from the minimal and metal speciation and metal speciation [36]. For example, at higher soil pH, Fe is less soluble, a by contouring internal and interctoral variables [3+1], [3-5], as were as simelear area sossoluble, and soption reactions between the negatively charged surfaces of Fe-oxyhydroxide and SOC are preferable to the formation o notation portion. The candings, at matter sourt put, it is reas solute, an solution teachinos between the negatively charged surfaces of Fe-oxyhydroxide and SOC are preferable to the formation of metal-humus complexes [37] Exercis in engativey transgue stances of crossby and as of the presenct of one and traces of metals due to the sorption of minerals, which the preservation of mobile cations and traces of metals due to the sorption of mine

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limestone soils maintain a higher SOC content than yellow soils.

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The class of the solid is the main factor affecting the change in *δ*¹³C in SOM with

stone soils maintain a higher SOC content than yellow soils.

The clay content in the soil IOP Publishing

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¹³C in SOM with

1 show an obvious

hysical protection

and leads to the 16 ference of Asian Rock Mechanics Society

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16. Limestone soils maintain a higher SOC content than yellow soils.

16. The c fc. Series: Earth and Environmental Science **861** (2021) 062046 doi:10.1088/1755-1315/861/6/062046

limestone soils maintain a higher SOC content than yellow soils.

The clay content in the soil is the main factor affect **From Example 10** IOP Publishing

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limestone soils maintain a higher SOC content than yellow soils.

The clay content in th fractional Rock Mechanics Society
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Ilmestone soils maintain a higher SOC content than yellow soils.

The clay content in forence of Asian Rock Mechanics Society

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limestone soils maintain a higher SOC content than yellow soils.

The clay conten The corresponding solid of Solid Corresponding Solid (2021) 062046 doi:10.1088/1755-1315/861/6/062046

limestone soils maintain a higher SOC content than yellow soils.

The clay content in the soil is the main factor affe i. Seites. Learn and Environmental Seiclet **601** (2021) 0020+0³ dol.10.106047153-151.5/601/60020+0

limestone soils maintain a higher SOC content than yellow soils.

The clay content in the soil is the main factor affec **EXECTS SIGNATE THEST SOCETTE THEST SOLUTE CONSTRANTS SOLUTE THE CALCUTE THE CALCUTE CONSTRANTS OF THE CALCUTE CONSTRANTS OF THE CALCUTE CONSTRANTS OF THE CONSTRANTS IN THE CONSTRANTS IN THE CONSTRANTS IN THE CONSTRANTS IN** The clay content in the son'ts the hall ractor antecting to
depth in the profile [38]. Limestone soil profiles have a high c
enrichment in clay from top to bottom soil [33]. The cher
provided by clay minerals reduces the r chment in clay from top to bottom soil [33]. The chemical and/or physical protection
vided by clay mimerals reduces the rate of decomposition of SOM and leads to the
tionation of a small C isotope. This may explain why th provided by clay minerals reduces the rate of decomposition of SOM and leads to the fractionation of a small C isotope. This may explain why the degree of ¹³C entichment in the SOM of limestone profiles is lower than i

fractionation of a small C isotope. This may explain why the degree of ¹⁴C enrichment in the SOM of limestone profiles is lower than in yellow soil profiles. At the same time, high content of clay in the soil, so that mo SOM of limestone profiles is lower than in yellow soil profiles. At the same time, high content of clay in the soil can lead to a decrease in the supply of oxygen to the deep layers of the soil, so that most areolose that of clay in the soil can lead to a decrease in the supply of oxygen to the deep layers of the soil, so
that most aeroseyonding soil depth at which the maximum ¹³C values of SOM appears is distinctly
small in limestone so that most aerobes that can decompose SOM exist only in the upper layer of the soil. As a result,
the corresponding soil depth at which the maximum ¹³C values of SOM appears is distinctly
small in limestone soil. The spe the corresponding soil depth at which the maximum ¹³C values of SOM appears is distinctly small in limestone soil. The specific reasons require further study in the future.
 4.2 Relationships of isotopic compositions b Il in limestone soil. The specific reasons require further study in the future.
 **Relationships of isotopic compositions between leaves of dominant plants, litters, and

soil SOM**

The chemical composition of plant resou litters, and

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topsoil SOM**
The chemposition of litter in forest soils [41], [42], [43]. However, much is unknown about how
litter quality affec 4.2 **Relationships or isotopic compositions between leaves or dominant plants, inters,**
topsoil SOM
The chemical composition of plant resources is considered important for predicting the
of decomposition of litter in f **n leaves or dominant plants, litters, and**

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IDENTIFY The chemical composition of plant resources is considered important for predicting the rate of decomposition of litter in forest soils [41], [42], [43]. However, much is unknown about how litter quality affects The chemical composition of plant resources is considered important for predicting the rate
of decomposition of litter in forest soils [41], [42], [43]. However, much is unknown about how
litter quality affects the amoun ered important for predicting the rate
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e the lowest $\delta^{13}C$ values,

with previous stu For extendant composition of plant issues as consisted miporal io planting to the decomposition of litter in forest solis [41], [42], [43]. However, much is inkhown about how litter quality affects the amount and chemical or accomposition of matrimost sois [*vri₁*], [*vr₂*], [*vri₂*], [*vri₂*], [*vri*₂], [*vrig*], [*vrig*], [*vrig*], [*urig*] (*t*) and the some for separate tracking of C and N retention and transformation, as sta at How

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³C and nter quanty uncess us annot antive transmination transmination of solicity and solicity respectively, larger than litter, This indicates that the differences between the value of $\delta^{13}C$ values, $\{147\}$, $\{148\}$. It In a dia-solope apploar was closed for separate tacking of C and *N* retention and
transformation, as stable isotope markers (¹³C, ¹⁵N) combined with the SOM fractionation
approach can be used to directly measure sta the SOM fractional and

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and $\delta^{15}N$ between the dominan ansonation, as suato solvey musicals (c, iv) connoticle with the GOM incompagneed can be used to directly measure stabilization rates and pathways of specific substrates among defined SOM pools on shorter time scales [38] bstrates
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derences δ^{15} N of litter and topsoil SOM in yellow sandstone soil are much smaller than the differences ppoare can be used to metcury massine same paints and pairways of specific substances
mong defined SOM pools on shorter time scales [38], [45].
It was observed that the dominant plant species usually have the lowest δ^{1 It was observed that the dominant plant species usually have the lowest $\delta^{13}C$ vi
followed by litter and finally the SOM of topsoil, which is consistent with previous studies
[47], [48]. However, we note that, in contr it was sosseived that in cominant plane species usarian process between to evaluate, β on evaluations of the plant lead transformation biological and biochemical transformations that β is a consistent with previous the enrichment of ¹³C in residual organic C in SOM, where the value of *δ*¹³C and the enrichment of 147]. [48]. However, we note that, in contrast to the δ^{13} C value, the average $\delta^{15}N$ values of plant litter ¹³ [+0],

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riginal ¹F₁, row-vect, we now una, in contuast or the C vance, the average of *N* vectual plant species and litter are nower than these of the plant leaf and SOM of the upper soil layers for both types of soil profiles (Tabl med are lower than those or the paint can strong or the upter son that position of the enrichment points of points (Table 2). The differences in the values of $\delta^{13}C$ and $\delta^{15}N$ between the dominant plant species and

son promates (and Σ). For interesting the humification process are the entired with the original plant mercies and litter are much smaller than between the litter and SOM of the topsoil. SOM in the upper layer of soil plant spectras and met at material material and other in the microson of the upportance of $\delta^{12}C$ by 2.6–3.0% and 5.5–6.3%, respectively, larger than litter. The same case is that SOM in topsoils of yellow sandstone an leading to an enrichment of 13C in microbial biomas as a value of σ is expectively, larger than litter. The same case is that SOM in topsoils of yellow sandstone and limestone soil profiles has a value of $\delta^{15}N$ by 2.0—3.7 owe and 3.3—3.7 respectively, anger unimital. The same case is set and soor in reposentively, larger than litter. This indicates that the differences between the values of δ^{13} N of litter and topsoil SOM in ye by enoty sanstor and ministone and interesting and value of b^3 or b^3 or b^3 or b^3 or b^3 or b^3 ².
Tespectively, larger than litter. This indicates that the differences between the values of δ^{13} C $\delta^{$ betavely, iaiger than inter. This indicates that the uniferences between the value of of litter and topsoil SOM in yellow sandstone soil are much smaller than t ween the litter and topsoil SOM in limestone soil. Biologic that the directions between the variats of *b* C and
andstone soil are much smaller than the differences
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The average smaller than the differences
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The average *δ*¹³C of
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ed to the emitted CO₂ ¹ so that and topsour ocher in y-tow sumstone soft are interesting humification processes lead to the enrichment of ¹³C in residual organic C in SOM [49]. For example, the value of δ^{13} C of lignin is approximatel

lower δ^{15} N values than the current leaves of the plant since the decomposition of organic matter 15N values than the current leaves of the plant since the decomposition of organic matter leads to enrichment with heavier isotopes in the residual materials. There are probably reasons for the interpretation. First, the usually leads to enrichment with heavier isotopes in the residual materials. There are probably Several reasons for the interpretation. First, the different plant species at the residual meter of δ ⁵N values than the current leaves of the plant since the decomposition of organic matter usually leads to enrichmen different $\delta^{15}N$ values; the difference in $\delta^{15}N$ values can reach several ‰. The litter, if it consists 15N values the different plant species of 1611 Fig. 14N (a decrease in *δ*¹⁵N from 2% to 3%) [51]. Finally, exoties the difference in *δ*¹⁵N values; the difference in *δ*¹⁵N values; the difference in *δ*¹⁵N value 10P Publishing

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1611 enter leaves of the plant since the decomposition of organic matter
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assally leads to enrichment with heavier isotopes in the residual materials. There are probably

several reasons for the int essent) reases to concument win meant-solonges in the Usabadar materials. First are protoury causaly different plant issues of different plant issues of different plant issues of different plant issues of different plant several reassors or an interpretation. This, use Carrelly and ¹acts, are served by the tile composition of the current plant issues of different plant issues of different plant issues of different plant has the mitted i if it consists
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Under the right of different plant issues of different plant species, has on average a lower or different $\delta^{15}N$ value

than the current plant leaf. Second, at the initial stage of decompos or unitant assass or unitary houses, ans on average a ower or unitarity of two the current plant leaf. Second, at the initial stage of decomposition, the residual litter is enriched in ¹⁴N (a decrease in $\delta^{15}N$ from mann to current putative composition of SOM in the mann stage of exceptional, the risostant nate is the mann of this is that the interduction of atmospheric NH₄⁺ into the litter reduces the value of $\delta^{15}N$ of litte Einter during their decomposition of some 1×1 or 20×10^{-11} . Furanty, extorulated an entic the technomic atmospheric NH₄⁺ into the litter reduces the value of $\delta^{15}N$ of litter, because NH₄⁺ is the main f nter during the the some soil and the SOM in the upper of this stand the minoduction of atmospheric NH₄⁺ into the litter reduces the value of $\delta^{15}N$ of litter, because NH₄⁺ is the main form of atmospheric depos able to the must have interest in value of δ^{15} N on average $-12.3 \pm 6.7\%$ around
from of atmospheric deposition and it shows a value of δ^{15} N on average $-12.3 \pm 6.7\%$ around
the sampling sites [52].
Like the For a multiple since the degradation and it shows a value of σ is of a vecting (12.5 ± 0.756) about 5.0% in pellow sandstone soil profiles and by about 7.0% in limestone soil profiles. One of the explanations for thi Elise the $\delta^{12}C$ values, the $\delta^{15}N$ values increase from the litter to topsoil SOM by about 5.0% in yellow sandstone soil profiles and by about 7.0% in limestone soil profiles. One of the explanations for this enric In yenow sandstone son promes and by about 7.000 in innestone son explanations for this enrichment in ¹⁵N and ¹³C due to SOM decay preferentially uses organic matter enriched in ¹⁴N and ¹²C [46]. The different valu Eventially uses organic matter enriched in ¹⁴N and ¹⁴C [46]. The differences in δ^{13} C and $\delta^{18}N$
In the topsoil of the topsoil of the linestone soil previous of the image greater, or, in other words,
M in the t values between litter and SOM in the topsoil of the limestone soil are greater, or, in other words,
SOM in the topsoil of limestone soil profiles is more enriched in ¹³C and ¹⁵N than litter
compared litter in yellow sa SOM in the topsoil of limestone soil profiles is more enriched in ¹³C and ¹⁵N than litter
compared litter in yellow sandstone soil profiles. This suggests that the rate of decomposition of SOM in the topsoil of limesto compared litter in yellow sandstone soil profiles. This suggests that the rate of decompositial degree of decomposition of SOM in the topsoil of limestone soil profiles is higher than in to of yellow sandstone, or that the rece of decomposition of SOM in the topsoil of limestone soil profiles is higher than in topsoil
relivew sandstone, or that the SOM in the upper layer of limestone soil was derived from old
etation different from the curre

of yellow sandstone, or that the SOM in the upper layer of limestone soil was derived from old vegetation different from the current vegetation cover. The latter interpretation is more reasonable since the degradation of S vegetation different from the current vegetation cover. The latter interpretation is more
reasonable since the degradation of SOM is usually faster or more intense in yellow sandstone
soil with a lower pH than in limestone reasonable since the degradation of SOM is usually faster or more intense in yellow sandstone

soil with a lower pH than in limestone soil with a higher pH.
 4.3 Degradation of SOM

Previous studies have shown that there soil with a lower pH than in limestone soil with a higher pH.
 4.3 Degradation of SOM

Previous studies have shown that there are significant correlations between SOC and SON

content, and these correlations are indicati **4.3 Degradation of SOM**

Previous studies have shown that there are significant correlations between SOC and SON

content, and these correlations are indicative of the main plant-derived N in soils [53]. As shown

in Fig **4.5 Degradation of SOM**
Previous studies have shown that there are significant correlations between SOC and SON
content, and these correlations are indicative of the main plant-derived N in soils [53]. As shown
in Fig. 7 Previous studies have shown that there are sig
content, and these correlations are indicative of the
in Fig. 7a, the SOC and SON contents are largely α
the main nitrogen supply to the soils of the karst are
In all soil Terrorios states lare shown that unce are signimar correlations oceaeurs of ocean solid in the selectrolled by the solis of the karst area.

It all solid Ispes, the content of SOC and SON decreases with increasing depth of comment, and these conventantions are inductantly of the main pani-excited is in sons [25]. As shown in Fig. 7a, the SOC and SON contents are largely correlated, which indicates that plants provide the main nitrogen supply in the minit of the soil, and both controlled by chemical completion of the effects of energy browned and particles, which is consistent with what has been observed in many studies [53], [54], [55], [56], [57]. However, th the Individual protection, and solving the entrication occurs and a minimum must have have that the solving that has been observed in many studies [53], [54], [55], [56], [57]. However, the extent of this reduction in SOC in an son types, us concient of oscil and soil vacter associations windicties is employed in the different soil profiles, the extent of this reduction in SOC concentration varies between different soil profiles (Fig. 3a).

are is soluss with was associated to all observed in many solutions [1931, [391, [391, [39], [36]. [39], [39], [39], [39], [39], [39], [39], [39], [39], [39], [39], [39] (This better of this reduction in SOC concentration nowever, the extent in the social man is occurred in the forms of Reamont and the sole of Forms 20 em to the bottom depth, on average, decreases by 7.1% in limestone soil and by 31.5% in yellow sandstone soil. SOC and SON IOP Publishing

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more resistant to degradation and exhibits an inherently slower decomposition rate [61], [62].

These factors These factors help to determine the overall biogeochemical stability of microbial and plant SOC, **Example 10** although the dominant mechanics Society

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more resistant to degradation and exhibits an inherently slower decomposition rate [6 ference of Asian Rock Mechanics Society
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more resistant to degradation and exhibits an inherently slower decomposition r
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more resistant to degradation and exhibits an inherently slower decomposition rate [61], [62] $13C_{\text{SOC}}$ and $\delta^{15}N_{\text{SON}}$ in **Solution Solution Solution** Society

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more resistant to degradation and exhibits an inherently slower deco fremce of Asian Rock Mechanics Society
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more resistant to degradation and exhibits an inher
These factors help to determine the overall biogeoch
although the dominant increase in $\delta^{13}C_{\text{SOC}}$ and $\delta^{15}N_{\text{SON}}$ values from topsoil to a depth of about 20–30 cm, and then 15Nson values from the decrease downward, with the δ^{13} Csoc values in example the same of about 20–31 cm, and exhibits an inherently slower decomposition rate [61], [62]. The to everall biogeochemical stability of mic fference of Asian Rock Mechanics Society

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rate [61], [62].

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more resistant to degradation and exhibits an inherently slower decomposition rate [61], [62].
These factors help to de more resistant to degradation and exhibits an inherently sld
These factors help to determine the overall biogeochemical s
although the dominant mechanisms will vary depending
available substrates, and abiotic driving vari depth profiles of the $\delta^{13}C_{SOC}$ and $\delta^{15}N_{SON}$ values for yellow sandstone soils can be attributed to exhibits an inherently slower decomposition rate [61], [62].
overall biogeochemical stability of microbial and plant SOC,
ms will vary depending on interactions between microbes,
ving variables.
(Fig. 7b). The depth profi These factors help to determine the contrains an intercting slower accomposition rate [origin]. [Degrading the dominant mechanisms will vary depending on interactions between microbes, available substrates, and abiotic dr an rate [01], [02].
al and plant SOC,
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Significant correlations were found between $\delta^{15}N$ and $\delta^{13}C$ in ye annough the dominant incentums with vary depending on meanwilable substrates, and abiotic driving variables.
Significant correlations were found between $\delta^{15}N$ and $\delta^{13}C$ in y
but not in limestone soil profiles (Fig almove successions, and overvien variables.

Significant correlations were found between $\delta^{15}N$ and $\delta^{13}C$ in yellow sandstone soil profiles

not in limestone soil profiles (Fig. 7b). The depth profiles of the δ^{1 but not interactions were counter of is a and or entropy sands out on the principal profiles of the δ¹³C_{80C} and δ¹⁵N_{50N} in yellow sandstone soil and limestone soil vary in different styles: the former shows a rap ou not in imession soi poonics (x_i , γ). The Gepur points of the γ encry and γ is equal to the solid and limestone soil vary in different styles: the former shows a rapid increase in $\delta^{13}C_{SOC}$ and $\delta^{15}N_{S$ ythow santstone som and mensation vary in unctional republic of the form is a republic since the space in $\delta^{13}C_{\text{SOW}}$ values from topsiol to a depth of about 20-30 cm, and then remains almost constant or increases re

Fremains almost constant or increases relatively slow downward, while the latter shows an increase from the topsoil to about 20 cm and then decrease downward, while the latter shows an increase from the topsoil being alm Fig. 8 shows the variations in $\delta^{13}C_{\text{SOC}}$ and $\delta^{15}N_{\text{SON}}$ variations in the composition of the topsoil being almost the same or even higher than those of the soidepth profiles of the $\delta^{13}C_{\text{SOC}}$ and $\delta^{15}N$ Fig. 8 shows the variations in $\delta^{13}C_{\text{SOC}}$ and $\delta^{15}N_{\text{SON}}$ values with the natural logarithm of SOC and EVENTE SOW COWINGTON, WHITE THE TRIGE SHOWS All then decrease downward, with the $\delta^{13}C_{SOC}$ values in igher than those of the soil at its deepest depth. The alues for yellow sandstone soils can be attributed to ontrast Exercise from the topson to about 20 can are not encreased to while the topsoil being almost the same or even higher than those of the soil at its depest depth. The depth profiles of the $\delta^{13}C_{SOC}$ and $\delta^{15}N_{SON}$ va Even out also the 13C and 15 N enrichment in the remaining SOM in deep soils can be a tributed to the decomposition of SOM by origin. In contrast, the depth profiles of the $\delta^{13}C_{SOC}$ values for limestone soils indi In profiles of the *δ* Soc and *δ* Nsols variats for yend *s* and solution of some the decomposition of SOM by origin. In contrast, the depth profiles of the limestone soils indicate a more complex origin or pedogenesis In contrast, the depth profiles of both $\delta^{13}C_{SOC}$ and $\delta^{15}N_{SON}$ values for limestone soils are more yenow santistime sons can be attributed to
the depth profiles of the $\delta^{13}C_{SOC}$ values for
dogenesis of limestone soil, which will be
onation of both ¹³C/¹²C and ¹⁵N/¹⁴N occurs
 $\beta^{13}C$ and ¹⁵N in the resid The discussion of 19 or 19 o complex, and there is no relationship between the $\delta^{13}C_{SOC}$ or $\delta^{15}N_{SON}$ values and the natural The state of the σ Csoc values for

I limestone soil, which will be

oth ¹³C/¹²C and ¹⁵N/¹⁴N occurs

V in the residual organic matter

tillation process, according to

the fraction of remaining SOC,

the origin lours solution that a more complex of som, indicating the decay of SOM.

in an open system, which leads to the concentration of both ¹³C/¹²C and ¹⁵N¹⁴N occurs

in an open system, which leads to the concentration $13C_{\text{SOC}}$ or $\delta^{15}N_{\text{SON}}$ values Exercise the interest and the composition of SOM, kinetic fractionation of both ¹³C/¹²C and ¹⁵N/¹⁴N
in an open system, which leads to the concentration of ¹³C and ¹⁵N in the residual organic
retained in the so

between δ^{13} C and δ^{15} N (b) in soils.

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Example to more than 1 m at the foot of the hill. In addition, the geothemical and pedological characteristics of linestone soil are heterogeneous, changing significantly even in a limited area.
Sandstone soil profiles. ^{26.9}

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 Eg.8. Variation of $\delta^{13}C$ (a) and $\delta^{15}N$ (b) depending on soil organic matter (SOM) in yellow

sandstone soil profiles.
 4.4 Implications for land-use change in limesto Soc content get $\frac{100}{1000}$ on $\frac{100}{64}$ on $\frac{10}{64}$ on $\frac{10$ 10.0

in yellow

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¹³C, but the

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13C content (g - kg⁺)

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13C content (g - kg⁺)

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13C in d δ¹⁵N (b) depending on soil organic matter (SOM) in yellow

sandstone soil profiles.
 or land -use change in limestone soils

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11. SOC content (g - kg⁻)

Fig. 8. Variation of $\delta^{13}C$ (a) and $\delta^{15}N$ (b) depending on soil organic matter (SOM) in yellow
 4.4 Implications for land-use change in limestone soils

The distribution of limestone soi Fig.8. Variation of $\delta^{13}C$ (a) and $\delta^{13}N$ (b) depending on soil organic matter (SOM) in yellow
sandstone soil profiles.
4.4 Implications for land-use change in limestone soils
The distribution of limestone soils i sandstone soil profiles.
 4.4 Implications for land-use change in limestone soils

The distribution of limestone soils in the karst landform is not contit

the depth of the soil. The depth of the soil varies from an ave **Implications for land-use change in limestone soils**
The distribution of limestone soils in the karst landform is not continuous and is uneven in
depth of the soil. The depth of the soil varies from an average depth of a **4.4 Implications for land-use change in imestone soils**
The distribution of limestone soils in the karst landform is not continuous and is uneven in
the depth of the soil. The depth of the soil varies from an average dep The distribution of limestone soils in the karst landform is not continuous and is uneven in
the depth of the soil. The depth of the soil varies from an average depth of about 20 cm on the
hillside to more than 1 m at the The usual is uncered to the mixing solicy and is uncered to depth of the soil. The depth of the soil article is the soil varies from an average depth of about 20 cm on the hillside to more than 1 m at the foot of the hill

been developed over the past few decades to explain the commonly observed $\delta^{13}C_{SOC}$ profiles are we wore sont interesting that we have some and avevage wepon and and pedological characteristics of limestone soil are heterogeneous, changing significantly even in a limited area.
Sandstone soil profiles usually show mission to more than 1 in at the tool of the limit. In aduntin, the goodicalitieal and potological developerations of all the depth profiles of $\delta^{13}C$ in limestone soil are complex, with the higher value of $\delta^{13}C$, Example of profiles usually show a simple tendency to increase the depth of δ ³C, but the depth profiles usually show a simple tendency to increase the depth of δ ³C, but the depth profiles of δ ³C in limesto Exercise the depth of $\delta^{13}C$, but the higher value of $\delta^{13}C$, in the topsoil
ier by Zhu and Liu [33] for two
stone soils distributed over a wide
iewed some hypotheses that have
mmonly observed $\delta^{13}C_{SOC}$ profiles someone sorial produces sustainy solve a simple catachery to increase the value of $\delta^{13}C$ in the topsoil
than in deep soil. This phenomenon was also observed earlier by Zhu and Liu [33] for two
limestone soil profiles. depth promes of σ C in infersion son are complex, while the
than in deep soil. This phenomenon was also observed earlier
limestone soil profiles. Accordingly, the pedogenesis of limesto
area in southwestern China is co Ensistone soil at the magnet value of $V =$ murd μ increases and reach encomenon was also observed earlier by Zhu and Liu [33] for two cordingly, the pedogenesis of limestone soils distributed over a wide is complex.

A man m components with different i³C content, and (3) hypotheses in the profiles. Accordingly, the pedogenesis of limestone soils distributed over a wide area in southwestern China is complex.

Ehleringer et al [14] and mrasson son promass. Accounguey, une pedegenesis of innession soils distinuted over a where are in somply
the characteristic and Balesdent et al (1993) [27] reviewed some hypotheses that have
been developed over the past and an southwested comments. The decrease to explain the commonly observed $\delta^{13}C_{SOC}$ profiles enriched with depth in well-drained mineral soils. In a discussion by Wynn et al [65], these hypotheses were grouped into 3 Example C at $11-3$ and backdoth of 20 cm and above, soil profiles were collected form the plot as the above of $\delta^{13}C_{SO}$ profiles enriched with depth in well-drained mineral soils. In a discussion by Wynn et al [65], between the plants. Than the plants than the collected from the sole plants. The absolution of the shypotheses were grouped into 3 categories: (1) hypotheses involving the mixing of SOM with different ¹³C content, (2) h Entrinct with a current are the soil and suspected to have left the soil and been erreades our erreption of C3 plants. The and the solid surface is nothing the mixing of SOM components with different ¹³C content, and (3 syous sove goodper mos 3 caugubus. (1) supposes involving the manalite decomposition of SOM components with different ¹³C content, and (3) hypotheses concerning the kinetic fractionation of C isotopes during SOM maturat amcient C content, (*z*) hyponeses involving the predominant
components with different ¹³C content, and (3) hypotheses concerning
of C isotopes during SOM maturation. The lowest values of $\delta^{13}C_{SOC}$ is
soils are obs ontests involving the protonimant eccomprission of SOM
ontent, and (3) hypotheses concerning the kinetic fractionation
ontation. The lowest values of $\delta^{13}C_{80c}$ in the profiles of limestone
t soil, similar to the valu components what uniterant ϵ content, and (*J*) hypotheses concerning the kind of C isotopes during SOM maturation. The lowest values of δ ¹³C_{SOC} in the profilis are observed for the deepest soil, similar to the The lowest values of $\delta^{13}C_{SOC}$ in the profiles of limestone
milar to the values in sandstone soil at the same depth.
of the profiles of limestone soils increase and reach a
20 cm, and then decrease to the soil surface or c isotopes untime booth matutation. The towest wattes of σ csoot in the pottinual or the same depth.
From bottom to top, the $\delta^{13}C_{SOC}$ values of the profiles of limestone soils increase and reach a
maximum value restoration.

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5 Conclusions

The amounts of SOC and SON are main

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The amounts of SOC and SON are mainly concentrated in the surfac 100 Publishing

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5 Conclusions

16. The amounts of SOC and SON are mainly concentrated in the surface layer o 100 Inference of Asian Rock Mechanics Society

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The amounts of SOC and SON are mainly concentrated in the surface lay mference of Asian Rock Mechanics Society
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5 Conclusions
The amounts of SOC and SON are mainly concentrated in the surface 1
decrease with increasing The dominant Rock Mechanics Society

The amounts of SOC and SON are mainly concentrated in the surface layer of the soil, and

The amounts of SOC and SON are mainly concentrated in the surface layer of the soil, are

The 13C values, followed by litter and,

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The amounts of SOC and SON are mainly concentrated in the surface 10P Publishing

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13C value, 10.1088/1755-1315/861/6/062046

13C value, the surface layer of the soil, and

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5 Conclusions

The amounts of SOC and SON are mainly concentrated in the surface the solution of SOC and SON are mainly concentrated in the surface layer of the soil, and decrease with increasing depth and appear in different amounts in different types of soils, with the SOM in limestone soil lening 13_C **5 Conclusions**

The amounts of SOC and SON are mainly concentrated in the surface layer of the soil, and

decrease with increasing depth and appear in different amounts in different types of soils, with

the SOM in lime ace layer of the soil, and

trent types of soils, with

low sandstone soil. The

gy, higher pH, and more

followed by litter and,

a verage $\delta^{15}N$ values of

upper soil layer for both

me soil profiles has $\delta^{13}C$
 From 5.1% to 5.0% and 5.0 m 6.5% to 5.1% to 5.3% and from 6.5% to 6.1%, which is more than in the sellar property and decrease with increasing depth and appear in different mounts in different types of soils, with the SOM The amounts of SOC and SON are mainly concedecrease with increasing depth and appear in differ
the SOM in limestone soil being significantly high
higher SOM content in limestone soil can be attribu
Ca ions than in yellow nts of SOC and SON are mainly concentrated
increasing depth and appear in different amou
imestone soil being significantly higher than
ontent in limestone soil can be attributed to so
n yellow sandstone soil.
nant plant C and SON are mainly concentrated in the surface layer of the soil, and
g depth and appear in different amounts in different types of soils, with
soil being significantly higher than in the yellow sandstone soil. The
lime The amounts of 500 and 50 v ate manny concentrated in the strated taj
decrease with increasing depth and appear in different amounts in different t
the SOM in limestone soil can be attributed to soil mineralogy, his
Ca io what increasing depth and appear in direction a
in limestone soil being significantly higher t
om content in limestone soil can be attributed t
aan in yellow sandstone soil.
lominant plant species usually have the lowes
e Solution and *a*ppear in uncertain annotation in the yellow sandstone soil. When the in limestone soil can be attributed to soil mineralogy, higher pH, and more ow sandstone soil. The tin limestone soil can be attributed which in imatesome soil. The differences of our in the space in the space of the phile of soil mineralogy, higher pH, and more Ca ions than in yellow sandstone soil. The dominant plant species usually have the lowest $\delta^{$ relationship that an increase in and outlined to some infinite that all the dominant plative and invest δ¹³C values, followed by finally, the SOM of topsoil. However, in contrast to the $δ$ ¹³C values, followed by fin throuted to soft inhertatogy, mgner pri, and increased to soft inhertatogy, mgner pri, and increase and δ^{13} C value, the average $\delta^{15}N$ values t leaves and SOM of the upper soil layer for bow sandstone and limeston of δ^{13} C values, followed by litter and,
st δ^{13} C values, followed by litter and,
 δ^{13} C value, the average δ^{15} N values of
nd SOM of the upper soil layer for both
pone and limestone soil profiles has δ^{1 Ca both and yellow sandstone soil.
The dominant plant species usually have the lowest $\delta^{13}C$ values, followed by litter and, finally, the SOM of topsoil. However, in contrast to the $\delta^{13}C$ values, the peper soil lay

The δ^{13} C and δ^{15} N values of SOM increase with depth in vellow sandstone soil profiles. The dominant plant species assamy have the lowest σ c values
finally, the SOM of topsoil. However, in contrast to the $\delta^{13}C$ value, t
the plant litter are lower than those of the plant leaves and SOM of th
types of b usually have the lowest *b* C values, follow
owever, in contrast to the δ^{13} C value, the avera
nose of the plant leaves and SOM of the upper
topsoils of yellow sandstone and limestone soil
to 3.0‰ and from 5.5‰ to mate the toward of the average of siN values of contract to the δ^{13} C value, the average δ^{15} N values of plant leaves and SOM of the upper soil layer for both yellow sandstone and limestone soil profiles has δ^{1 mlany, the 50M of topson. However, in contrast to the *θ* C
the plant litter are lower than those of the plant leaves and SO
types of soil profiles. SOM in topsoils of yellow sandstone are
values, respectively, from 2.6‰ 13C and $\delta^{15}N$ in deeper soil increasing soil and soil accumulation. Compared by $\delta^{13}C$ and $\delta^{15}N$ and $\delta^{15}N$ and $\delta^{16}N$ and $\delta^{16}N$ in topsoils of yellow sandstone and limest in 2.6‰ to 3.0‰ and from 6. 19N values of the *θ* C walue, the average *θ* Tw values of
soils of the plant leaves and SOM of the upper soil algor for both
soils of yellow sandstone and limestone soil profiles has $\delta^{13}C$
3.0% and from 5.5% to 6.3 then the dency than those of the paint can be over the appear son to pullon supplet that a content with the depth soil profiles has δ^{12} C values, respectively, from 2.6% to 3.0% and from 5.5% to 6.3%, and $\delta^{18}N$ va types or son points. Soin in copsons of yellow sandstone and imission end imission is promines in so changes in particulation. The differences between the $\delta^{13}C$ and $\delta^{15}N$ values of B. δ^{16} and from 5.5% to 8.3 **EXECUTE 10** is the *S*¹³ consideration, it is the litter and SOM of 0.5%, and σ is variation in *S*, 1% and from 5.1% and from 6.5% to 8.1%, which is more than in litters. The from 5.1% to 5.4% and from 6.5% to 8.1 13C and *S*DM of topsoil, and *δ* 13 variats, respectively, which is more than in litters. The difference and SOM of topsoil in yellow sandstone soil profiting and SOM of topsoil in yellow sandstone soil profiting and *δ* is more than in litters. The differences
 A of topsoil in yellow sandstone soil are

depth in yellow sandstone soil profiles,

intense with increasing soil depth. The
 $\delta^{15}N$ with a decrease in SOM content in

mposit Clay content, and interest in the state of $\delta^{13}C$ and $\delta^{15}N$ values of the litter and SOM of topsoil in yellow sandstone soil are significantly less than in limestone soil.
The $\delta^{13}C$ and $\delta^{15}N$ values of SOM profiles. yellow sandstone soil significantly justifies the decomposition of SOM and, therefore, causes
increase in the values of $\delta^{13}C$ and $\delta^{15}N$ in deeper soil horizons of yellow sandstone soil
files. However, the $\delta^{13}C$ an increase in the values of $\delta^{13}C$ and $\delta^{15}N$ in deeper soil borizons of yellow sandstone soil
profiles. However, the $\delta^{13}C$ and $\delta^{15}N$ values of SOM in limestone soil profiles have a complex
tendency to chan

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profiles. However, the $\delta^{12}C$ and $\delta^{15}N$ values of SOM in limestone soil profiles have a complex
tendency to change with increasing soil depth and SOM content, which can be mainly attributed
to changes in land use a Endency to change with increasing soil depth and SOM content, which can be mainly attributed
to changes in land use and soil accumulation. Compared to yellow sandstone soil profiles,
limestone soil profiles have less vari To changes in land use and soil accumulation. Compared to yellow sandstone soil profiles, limestone soil profiles have less variation in $\delta^{13}C$ and $\delta^{15}N$ values, mainly due to soil pH value, clay content, and highe Elements and higher amounts of calcium and magnesium elements present in limestone soil profiles have less variation in $\delta^{13}C$ and $\delta^{15}N$ values, mainly due to soil pH value, elay content, and higher amounts of calc clay content, and higher amounts of calcium and magnesium elements present in limestone soil
profiles.
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