The mechanism of forest ground fire is thermal decomposition and smoldering combustion of forest peat or duff. The availability of oxygen is believed to influence the processes. This paper aims to investigate the thermal decomposition of peat under inert and oxidative atmospheres. Experiments were monitored under nitrogen and air atmospheres, using the non-isothermal thermogravimetric (TG) and differential thermal analysis (DTA) methods. The pyrolysis curves of peat showed three main stages, i.e., the stage of moisture evaporation (together with low stability of organic compounds) (315–432 K, with the heating rate of 10 K/min), organic matter pyrolysis (432–805 K), and inorganic compound decomposition (805–1075 K). The stage of organic matter pyrolysis also contained three steps, corresponding to hemicellulose, cellulose, and lignin pyrolysis. Because the temperature of inorganic compound decomposition was higher than the peat-smoldering temperature, this stage of inorganic compound decomposition was not important for peat pyrolysis. Therefore, the peat pyrolysis processes were simulated using reactions of four fractions: moisture, hemicellulose, cellulose, and lignin. In the combustion curves, the inorganic compound decomposition stage was not distinct, while the organic matter pyrolysis stage became two consecutive stages, i.e., the stage of organic matter decomposition (427–575 K) and char oxidative combustion (575–800 K). A scheme containing moisture evaporation (together with low stability of organic compounds) and two consecutive reactions was proposed to simulate the combustion processes. The good agreement between the experimental and simulated curves validated the proposed models for pyrolysis and combustion of peat. The kinetic parameters of main components/steps were compared to those reported for lignocellulosic biomass.

1. Introduction

A ground forest fire consumes the organic material beneath the surface litter ground and is characterized by burning without flames and spreading very slowly. During a ground fire, the organic materials (remains of plants, animals, and microorganisms) in soil are decomposed and smoldering-combusted, leading to the release of a variable proportion of organic carbon reserved in soil to the atmosphere as CO₂ or CO. Therefore, it is very harmful to the forest ecosystem and atmosphere quality. In Chinese Northeast forests where ground fire often happens, peat or duff is the main fuel for smoldering combustion. It is important to understand the mechanism of peat fire and to establish more effective methods to control it.

Peat is a type of soil composed of piles of organic materials originating from plant remnants, which are in or have been in the process of decomposition. Because it is composed of organic materials, peat can be ignited and burned when some appropriate conditions are met. It was believed that the major factors controlling sustained smoldering of peat moss were moisture, organic materials, and mineral contents. The ignition probability was linked to these factors by logistic models. Although these studies identified the apparent influencing factors and were important for forest fire protection engineering, the mechanism of peat-smoldering fire was not revealed. The physical and chemical processes in peat-smoldering fire need more investigations.

Because peat is a kind of biomass, it should be decomposed to flammmable volatiles first before burning. Thus, the thermal decomposition process of peat should be studied to understand peat-smoldering fire. Usup et al. studied the decomposition process of Indonesia forest peat in air by thermogravimetric—differential thermal analysis (TG—DTA) techniques, and the ignition temperature was approximated by DTA curves. However, the decomposition kinetics were not studied, although they are important for smoldering simulation.

In ground fire, peat-smoldering fires can be burn in shallow or deep fronts. Shallow front fires burn near the free surface and are open to the atmosphere, thus having large supplies of...
oxygen available. Deep subsurface fires burn many meters below the ground and, thus, have a limited supply of oxygen. The availability of oxygen will influence the thermal decomposition process of peat. The effect of the presence of oxygen should be reflected in the simulation of peat smoldering.

Peat is also one kind of biomass renewable resource and can be used in thermochemical conversion processes aimed at the production of energy and chemical products. Pyrolysis is one of the effective methods of biomass processing into combustible gases, oils, and solid carbon-containing residues. It is also important to study the thermal decomposition of peat for renewable energy industries.

This paper will study thermal decomposition of Chinese forest peat under inert and oxidative atmospheres by the non-isothermal TG and DTA techniques. The effect of oxygen availability will be discussed, and the decomposition kinetics will be proposed. This work will be important for the understanding of peat-smoldering fire and helpful for peat conversion.

2. Experimental Section

2.1. Samples. The peat samples employed in this study were original peat blocks, collected from the Changbai Mountain forest in northeast China. The size of each block is about 15 cm, and some rotten plant leaves and branches can be seen. The blocks were air-dried naturally, ground, and then sieved, so that the particle size was specified to be in the range of 100–150 μm. The powder samples were subjected to dynamic thermal decomposition experiments.

The elements in the samples were identified by an X-ray fluorescence spectrometer (Shimadzu XRF-1800). It was found that the main elements are carbon and oxygen (totaling 55.9% mass), indicating that organic materials are abundant. Peat also contains many mineral elements, such as silicon, iron, calcium, and aluminum, totaling up to 29.6% mass. The minerals are important for plant growth; however, they also make the decomposition process of peat more complex.

2.2. Thermal Analysis Experiments. A Shemadzu DTG-60H thermogravimetric analyzer was used to record TG and DTA curves of peat decomposition simultaneously. The initial amounts of the sample were all kept at 10 mg or so for the experiments. In each experimental run, the furnace temperature was increased from room temperature to 1073 K until the sample mass was nearly constant, at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\). Table 1 shows that the mass loss percent of peat-smoldering fire and helpful for peat conversion.

3. Pyrolysis: Results and Discussion

3.1. Experimental Results. Figure 1 shows the experimental TG and derivative thermogravimetry (DTG) plots for peat pyrolysis in nitrogen at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\). It is shown that there are three main mass loss stages for peat pyrolysis.

The first mass loss stage occurs from room temperature to about 430 K and accounts for 12, 11, and 13% of the total mass loss for experiments at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\), respectively (see Table 1). The mass loss peak appears at

Figure 1. TG and DTG curves of peat pyrolysis in nitrogen at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\).
Table 1. Characteristic Parameters of the TG–DTG Curves of Peat Pyrolysis in Nitrogen

<table>
<thead>
<tr>
<th>Pyrolysis stage</th>
<th>Heating rate (K min(^{-1}))</th>
<th>Onset temperature (K)</th>
<th>Final temperature (K)</th>
<th>Peak temperature (K)</th>
<th>Maximum mass loss rate (K(^{-1}))</th>
<th>Average mass loss rate (K(^{-1}))</th>
<th>Ratio of mass loss/total mass (%)</th>
<th>Ratio of mass loss/sample mass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>7.5</td>
<td>315</td>
<td>432</td>
<td>344</td>
<td>0.0015</td>
<td>0.0006</td>
<td>12</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>315</td>
<td>436</td>
<td>348</td>
<td>0.0013</td>
<td>0.0006</td>
<td>11</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>309</td>
<td>434</td>
<td>357</td>
<td>0.0014</td>
<td>0.0006</td>
<td>13</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>432</td>
<td>805</td>
<td>566 (599)</td>
<td>0.0029</td>
<td>0.0013</td>
<td>72</td>
<td>47.1</td>
</tr>
<tr>
<td>Second</td>
<td>10</td>
<td>438</td>
<td>802</td>
<td>572 (603)</td>
<td>0.0030</td>
<td>0.0013</td>
<td>74</td>
<td>47.6</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>434</td>
<td>841</td>
<td>576 (612)</td>
<td>0.0028</td>
<td>0.0012</td>
<td>76</td>
<td>47.1</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>805</td>
<td>1075</td>
<td>954</td>
<td>0.0009</td>
<td>0.0004</td>
<td>16</td>
<td>10.4</td>
</tr>
<tr>
<td>Third</td>
<td>10</td>
<td>802</td>
<td>1075</td>
<td>954</td>
<td>0.0007</td>
<td>0.0003</td>
<td>15</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>841</td>
<td>1075</td>
<td>940</td>
<td>0.0005</td>
<td>0.0003</td>
<td>11</td>
<td>7.0</td>
</tr>
</tbody>
</table>

\(^a\) Two peaks appear in the second pyrolysis stage, and the data in the parentheses are the second peak temperature of this stage.

Figure 2. DTA curves of peat pyrolysis in nitrogen at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\).

The third mass loss stage begins from 800 K and is more obvious between 900 and 1050 K. At such a high temperature, the minerals in peat decompose. DTG curves in Figure 1 present slight endothermic peaks, which are in accordance with the decomposition characteristics of some minerals, such as calcium carbonate. Because the typical temperature of peak smoldering fire is between 773 and 873 K, which is lower than the temperature range of the mineral decomposition process, it is not necessary to study the kinetics of mineral decomposition for modeling peat combustion.

3.2. Pyrolysis Model. As stated above, the moisture evaporation stage and organic material pyrolysis stage are responsible for peat-smoldering fire. The moisture evaporation stage can be modeled by a reaction, and the organic material pyrolysis stage can be modeled by three-component reactions. Therefore, the peat pyrolysis can be simulated using four fractions in peat: moisture (M), hemicellulose (H), cellulose (C), and lignin (L). Each fraction undergoes thermal evaporation/decomposition, following a nth-order kinetic model. The global pyrolysis of peat is the combination of several individual processes.

Scheme 1

\[
M \rightarrow V_M \\
H \rightarrow V_H + R_H \\
C \rightarrow V_C + R_C \\
L \rightarrow V_L + R_H
\]

Scheme 1 depicts peat pyrolysis, where \(V_i\) represents volatiles or vapors and \(R_i\) represents solid residues of each reaction.

For the mass loss process of each fraction, it is necessary to solve eq 1 for each fraction to describe peat pyrolysis

\[
\frac{\text{d}a_i}{\text{d}T} = \frac{A}{\beta} e^{-\frac{E_i}{RT}} (1 - \alpha_i)^n
\]

Here, the variable \(\alpha_i = (W_0 - W_i)/(W_0 - W_{\infty})\) is the degree of transformation of the ith fraction.

In TG analysis, the weight of sample \((W)\) is recorded and the overall conversion \((\alpha)\) can be defined as

\[
\alpha = \frac{W_0 - W}{W_0 - W_{\infty}}
\]

Here, \(W_0\) is the initial weight of sample, and \(W_{\infty}\) is the sample weight at the end of the organic material pyrolysis stage.

On the other hand, the weight of the sample is the sum of weights of individual fractions, that is

\[
W_0 - W = \sum_i W_0 - W_i = \sum_i (W_0 - W)
\]

Thus

\[
\alpha = \frac{\sum_i a_i (W_0 - W_i)}{W_0 - W_{\infty}} = \sum_i r_i \alpha_i
\]

With \(r_i = (W_0 - W_i)/(W_0 - W_{\infty})\), which is the yield coefficient of fraction \(i\) and \(\sum r_i = 1\). The parameter \(r_i\) reflects the ratio of the mass loss of fraction \(i\) to the total mass loss during the pyrolysis process.

The overall rate of conversion is given by

\[
\frac{\text{d}\alpha}{\text{d}T} = \sum_i r_i \frac{\text{d}a_i}{\text{d}T} = \sum_i r_i \frac{A_i}{\beta} e^{-\frac{E_i}{RT}} (1 - \alpha_i)^n
\]
The item of $1 - \alpha_i$ in eq 5 can be expressed through the Coats–Redfern equation:

$$
\ln \left( \frac{g(\alpha)}{T^2} \right) = \ln \left( \frac{AR}{nE} \right) \left[ 1 - \frac{2RT}{E} \right] - \frac{E}{RT}
$$

where $g(\alpha)$ is defined as $g(\alpha) = \frac{d\alpha}{d(\alpha/RT)}$. If $n = 1$, $g(\alpha) = -\ln(1 - \alpha)$, and if $n \neq 1$, $g(\alpha) = (1 - (1 - \alpha)^{1-n})/(1 - n)$.

After $1 - \alpha_i$ is expressed by eq 6, eq 5 can be rewritten as follows:

$$
n = 1, \frac{d\alpha}{dT} = \sum_i r_i A_i \beta e^{-E_i/RT} e^{-A_iRT^2/\beta E_i(1 - (2RT/E_i))\exp(-E_i/RT)}
$$

$$
n \neq 1, \frac{d\alpha}{dT} = \sum_i \frac{A_i}{\beta} e^{-E_i/RT} \left[ 1 - \frac{A_iRT^2}{\beta E_i} (1 - n_i) \left( 1 - \frac{2RT}{E_i} \right) e^{-E_i/RT} \right]^{n_i/1 - n_i}
$$

The simultaneous determination of the kinetic parameters for each reaction was performed by minimizing the $S_{DTG}$ coefficient of the $N$ experimental data ($T$ and $d\alpha/dT$)

$$
S_{DTG} = \sum_j S_j = \sum_j \sum_k \left[ (d\alpha/dT)_{exp} - (d\alpha/dT)_{calc} \right]^2
$$

where the superscripts of “exp” and “calc” are the experimental and calculated values. $j$ is the number of experimental curves, and $k$ is the number of data points of each experimental curve. The minimization of $S_{DTG}$ was carried out with the Levenberg–Marquardt nonlinear fitting algorithm in thermokinetic software.

One parameter, Dev, is proposed to evaluate the deviation between the experimental and calculated curves as follows:

$$
Dev = 100\% \left[ \frac{\sqrt{\sum_j (Z_j - N_j)^2}}{\max(\sum_j (d\alpha/dT)_{exp}/j)} \right]
$$

where $Z$ is the number of data points and $N$ is the number of independent parameters needed to be determined in the simulation. This parameter shown in Table 2 is very low and indicates the good matching of the experimental and calculated curves. As an example, Figure 3 shows the experimental and calculated DTG curves at a heating rate of 10 K min$^{-1}$, and the curves are in a good agreement.

The kinetic parameters shown in Table 2 correlate experimental and calculated data for all heating rates. For the water evaporation stage, the activation energy is 61.38 kJ mol$^{-1}$.

or another integer (3 for lignin in ref 32). The parameters in Table 2 show that the mass loss ratio for cellulose is lower and the mass loss ratio for lignin is higher than the corresponding values for lignocellulosic biomass. Cellulose may decompose by bacteria or microorganisms in nature. The activation energy (120.63 kJ mol\(^{-1}\)) for cellulose pyrolysis is lower than the value range of 195–286 kJ mol\(^{-1}\); however, it is comparable to those reported in ref 31. The kinetic parameters for hemicellulose and lignin are similar to those that appeared in ref 19.

### 4. Combustion: Results and Discussion

#### 4.1. Experimental Results

Figure 4 shows the experimental TG and DTG plots for peat combustion in air at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\). It is also shown that there are three main mass loss stages for peat pyrolysis. The first mass loss stage occurs from room temperature to about 430 K and is associated with moisture evaporation.

The second mass loss stage occurs in the temperature range of 427–575 K for the experimental run at 10 K min\(^{-1}\). When the temperature rises from 427 K for the DTG curve at a heating rate of 10 K min\(^{-1}\), the decomposition rate of organic materials increases and reaches the maximum (0.0210 K\(^{-1}\); see Table 3) at 549 K. Then, the rate decreases and transits to another mass loss stage at 575 K. The second mass loss stage accounts for 68% of the total mass loss of peat combustion. The DTA curves shown in Figure 5 indicate that this stage is strongly exothermic. It can be inferred that, in this stage, the organic components of peat decompose to the volatiles and char residues and the flammable components of the generated volatiles continue to combust in air and present strong exothermic peak in the DTA curve (Figure 5). However, in nitrogen, a mass loss peak in the DTG curve (Figure 6) and an exothermic peak in the DTG curve of peat combustion in nitrogen at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\) can be found in Figures 1 and 4, respectively, are redrawn in Figure 6. The DTA curves under different atmospheres can be found in Figures 2 and 5.

Figure 5. DTA curves of peat combustion in air at heating rates of 7.5, 10, and 12.5 K min\(^{-1}\).

Before about 450 K, the two DTG curves in Figure 6 almost coincide, which indicates that the mass loss rate of peat decomposition in air and nitrogen atmospheres is almost the same. This is because the mass loss is attributed to moisture evaporation, and the oxygen effect is negligible. In Figures 2 and 5, DTA curves also coincide to present an endothermic process.

During the temperature range of nearly 450–580 K, the mass loss rate in air is about 10 times higher and the onset temperature is slightly lower than those in nitrogen. In this temperature range, hemicellulose and cellulose begin to decompose. When oxygen is available, the gaseous decomposition volatiles can burn with oxygen and promote the volatilization rate. This burning process is reflected by a sharp exothermic peak in the DTA curve (see Figure 5).

During the temperature range of 580–800 K, the solidate decomposition products continue to combust in air and present a mass loss peak in the DTG curve (Figure 6) and an exothermic peak in the DTG curve (Figure 5). However, in nitrogen, the mass loss process in 580–800 K is slow and the thermal effect is not obvious (Figure 2). Beyond 800 K, the effect of the atmosphere on the mass loss process is not distinct.

#### 4.2. Comparison to Pyrolysis Results

As stated in the Introduction, peat may decompose in inert or oxidative atmospheres in ground fire and the decomposition process is influenced by the presence of oxygen. We can compare the TG–DTG and DTA curves of peat decomposition in air and nitrogen atmospheres to illustrate the oxygen effect. To make the comparison more clear and visible, the TG–DTG curves at a heating rate of 10 K min\(^{-1}\) under nitrogen and air atmospheres, which can be found in Figures 1 and 4, respectively, are redrawn in Figure 6. The DTA curves under different atmospheres can be found in Figures 2 and 5.

Beyond 800 K, the variation of the sample mass is undetectable. The mineral decomposition process is not obvious in air.

#### 4.3. Combustion Model

Section 4.1 illustrates that there are three stages in peat combustion: dehydration, oxidative degradation of main components, and oxidation of the formed char. Barneto et al.\(^{33}\) showed similar mass loss behaviors for peat combustion in air.

![DTA Curves of Peat Combustion in Air](image-url)

### Table 3. Characteristic Parameters of the TG–DTG Curves of Peat Combustion in Air

<table>
<thead>
<tr>
<th>Combustion stage</th>
<th>Heating rate (K min(^{-1}))</th>
<th>Onset temperature (K)</th>
<th>Final temperature (K)</th>
<th>Peak temperature (K)</th>
<th>Maximum mass loss rate (K(^{-1}))</th>
<th>Average mass loss rate (K(^{-1}))</th>
<th>Ratio of mass loss / total mass loss (%)</th>
<th>Ratio of mass loss / sample mass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>7.5</td>
<td>304</td>
<td>429</td>
<td>344</td>
<td>0.0014</td>
<td>0.0006</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>310</td>
<td>427</td>
<td>357</td>
<td>0.0092</td>
<td>0.0005</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>301</td>
<td>438</td>
<td>348</td>
<td>0.0013</td>
<td>0.0006</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>429</td>
<td>568</td>
<td>550</td>
<td>0.0259</td>
<td>0.0041</td>
<td>67</td>
<td>57</td>
</tr>
<tr>
<td>Second</td>
<td>10</td>
<td>427</td>
<td>575</td>
<td>549</td>
<td>0.0210</td>
<td>0.0038</td>
<td>68</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>438</td>
<td>581</td>
<td>548</td>
<td>0.0178</td>
<td>0.0039</td>
<td>69</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>568</td>
<td>800</td>
<td>628</td>
<td>0.0019</td>
<td>0.0004</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>Third</td>
<td>10</td>
<td>575</td>
<td>800</td>
<td>632</td>
<td>0.0020</td>
<td>0.0004</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>581</td>
<td>800</td>
<td>634</td>
<td>0.0016</td>
<td>0.0004</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>


Here, \( r_w \) represents the ratio of the mass loss of the moisture evaporation stage to the total mass loss, while \( r_{dp} \) represents the ratio of the mass loss of peat decomposition to the mass loss of peat decomposition and char oxidation stages.

The simulated curves were generated by eq 12 and compared to the experimental curves. The difference quantity shown as eq 8 was minimized through optimization iteration computation. Then, the optimum kinetic parameters can be determined and are shown in Table 4. Figure 7 shows the experimental and calculated DTG curves at a heating rate of 12.5 K min\(^{-1}\), and the curves are in a good agreement.

The kinetic parameters for the moisture evaporation stage shown in Table 4 are close to those shown in Table 2, indicating that the effect of the presence of oxygen on this stage is negligible. As for the combustion process with peat decomposition and char oxidation, the parameters are comparable to those for cellulose component combustion in ref 33. In that paper, the kinetic triplets \((E, \ln A, n)\) are 191.79, 33.59, and 2.85 for cellulose devolatilization and 150.42, 20.10, and 1.00 for char oxidation, respectively. It can be seen that the activation energies in Table 4 are slightly higher. In ref 40, the activation energy of char combustion is 166.17 kJ mol\(^{-1}\) and closer to the value in Table 4. However, more investigations presented lower activation energies for biomass decomposition in air,\(^{6,16}\) which may be attributed to the reactivity of different kinds of biomass and the formed chars.

### 5. Conclusion

In this work, thermal decomposition characteristics of Chinese forest peat under inert and oxidative atmospheres were determined using non-isothermal TG analysis and DTA. Kinetic analysis was carried out for peat pyrolysis and combustion using the nonlinear fitting algorithm.

### Table 4. Apparent Kinetic Parameters of Each Reaction in Scheme 2 for Peat Combustion

<table>
<thead>
<tr>
<th>Reaction</th>
<th>( W )</th>
<th>( \text{dry peat decomposition} )</th>
<th>( \text{char oxidation} )</th>
<th>Deviation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ln A ) (s(^{-1}))</td>
<td>8.30</td>
<td>20.49</td>
<td>13.74</td>
<td></td>
</tr>
<tr>
<td>( E ) (kJ mol(^{-1}))</td>
<td>68.51</td>
<td>233.62</td>
<td>192.14</td>
<td></td>
</tr>
<tr>
<td>( n )</td>
<td>2.50</td>
<td>1.24</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>( r )</td>
<td>0.095</td>
<td>0.74</td>
<td>0.26</td>
<td>3.43</td>
</tr>
</tbody>
</table>

Peat pyrolysis processes included three main stages: moisture evaporation (together with low stability of organic compounds), organic matter pyrolysis, and inorganic compound decomposition. The organic matter pyrolysis also included hemicellulose, cellulose, and lignin pyrolysis. Except for the inorganic compound decomposition stage, which was not important for peat smoldering, peat pyrolysis processes were simulated well using reactions of four fractions: moisture, hemicellulose, cellulose, and lignin.

In the peat combustion process, after moisture evaporation, the combustion curves presented two consecutive stages: organic matter decomposition and char oxidation. A scheme containing moisture evaporation and two consecutive reactions was proposed to simulate the combustion processes and validated by the good agreement between the experimental and simulated curves.

By comparing peat pyrolysis and combustion curves, the effect of the presence of oxygen on thermal decomposition processes was evaluated. From 427 to 575 K, the presence of oxygen increased the decomposition rate of organic components in peat. From 575 to 800 K, oxygen contributes to slow char oxidation.

The present study can contribute to the understanding of the difference of peat-smoldering fires in shallow or deep fronts. The proposed kinetic schemes can be used in modeling peat combustion. This work is also meaningful for the thermal conversion of peat.

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