

# TECHNICALLY CORRECT: USING TECHNOLOGY TO SUPPLEMENT DUE DILIGENCE STANDARDS IN EASTERN D.R. CONGO CONFLICT MINERALS MINING

*Harry D. Gobrecht\**

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\* J.D., University of Illinois College of Law, 2012; B.S. in Chemical Engineering and Nuclear Engineering, University of California, Berkeley, 2007. I am indebted to Prof. Keenan and his International Human Rights Clinic for the genesis of this topic. I would also like to thank my family, whose love and support have been invaluable to this and all endeavors.

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## I. INTRODUCTION

Since the Second Congo War, the eastern part of the Democratic Republic of the Congo (“D.R. Congo”) has been war-torn with a range of armed groups controlling mines and the local populations who service them.<sup>1</sup> While the Second Congolese war officially ended on July 20, 2002 when the Pretoria Accord was signed, the armed groups are essentially continuing that conflict today. This continuation is funded in large part by the control, sale, taxation, and exportation of so called “conflict minerals.”<sup>2</sup> Armed groups, rebels, and the national military alike, control over 50% of the mining sites in eastern D.R. Congo.<sup>3</sup> In addition to controlling the mines, the armed groups also control the roads and participate in smuggling.<sup>4</sup> This note will discuss efforts to stymie this conflict and how new technologies can help.

Part II will give background for many of the moving parts in this problem. This background information will include definitions of what the conflict minerals are, explain how they are used by industry, and detail how they finance armed groups. The section will then go on to discuss current policies of the D.R. Congo and the United States in dealing with conflict minerals. Finally, the background will conclude with a discussion of some high-tech tracking techniques that could be used to determine or certify the source of conflict minerals.

Part III will take a look at what can be gleaned from a closer inspection of data on conflict minerals. It will show how current due diligence schemes are incomplete and how the high tech solutions mentioned can help to round out these schemes.

Part IV will recommend complementing traditional due diligence techniques with the implementation of these high tech solutions. It will stress how these solutions can be flexible, easy to implement, and could produce a wealth of accurate data that could be used not just to combat conflict minerals, but to gain a deeper overview of mineral supply chains anywhere in the world.

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1. GLOBAL WITNESS, “FACED WITH A GUN, WHAT CAN YOU DO?”—WAR AND THE MILITARISATION OF MINING IN EASTERN CONGO 4 (2009), available at [http://www.globalwitness.org/sites/default/files/pdfs/report\\_en\\_final\\_0.pdf](http://www.globalwitness.org/sites/default/files/pdfs/report_en_final_0.pdf).

2. *Id.*

3. Lydia Polgreen, *Congo’s Riches, Looted by Renegade Troops*, N.Y. TIMES, Nov. 15, 2008, at A1, available at <http://www.nytimes.com/2008/11/16/world/africa/16congo.html>.

4. *Id.*

## II. BACKGROUND

To better understand the issues at hand, we first need to discuss briefly the minerals themselves. The minerals are the fuel of the conflict and an understanding of some important details of the minerals is essential for the technological discussion that this Note provides for later in this section. This Note will then go on to give a summary of the situation in the D.R. Congo and what D.R. Congo and the United States are doing.

This section ends with a discussion of compelling technology-based solutions that have been recommended or requested by a number of organizations, either dealing directly with the D.R. Congo conflict minerals issue or analogous conflict resource issues in Africa. These recommended techniques range from electronic bills of lading to chemical spiking to detailed chemical analysis to determine the origin of a mineral.

### A. Conflict Minerals

The minerals that fund armed groups in D.R. Congo are some of the most vital minerals in the production of consumer electronics. They are the “3T’s”—that is, tungsten, tantalum and tin—as well as gold.<sup>5</sup> These “conflict minerals” fund warfare and enslavement of local populations, much in the same way diamonds did in Angola,<sup>6</sup> Liberia,<sup>6</sup> Sierra Leone, Cote d’Ivoire, Western D.R. Congo, the Republic of Congo, and Zimbabwe.<sup>7</sup>

#### 1. What About African Diamonds?

Conflict minerals are not the first resources that have fueled bloodshed in Africa. Diamonds came before them. The infamous “blood diamonds” have been dealt with for years; unfortunately, many of the procedures in place to control African diamonds would be ineffective for conflict minerals.

In order to combat conflict diamonds, industry groups and the United Nations created what came to be called the Kimberly Process Certification Scheme.<sup>8</sup> It has a number of requirements. First, each shipment of rough diamonds that crosses an international border must be in a tamper-proof container and accompanied by a government-validated certificate, stating that the diamonds are “conflict free.”<sup>9</sup> These certificates must have protections against forgery, be individually numbered, and describe the contents of the container.<sup>10</sup> Second, a Kimberly participant country can only receive and send

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5. Mary Beth Sheridan, *U.S. Financial Reform Bill Also Targets ‘Conflict Minerals’ from Congo*, WASH. POST, July 20, 2010, <http://www.washingtonpost.com/wp-dyn/content/article/2010/07/20/AR2010072006212.html>.

6. Philippe le Billon, *Angola’s Political Economy of War: The Role of Oil and Diamonds, 1975–2000*, 100 AFR. AFF. 55, 59 (2001), available at <http://afaf.oxfordjournals.org/content/100/398/55.short>.

7. Elisabeth Gilmore et al., *Conflict Diamonds: A New Dataset*, 22 CONFLICT MGMT. & PEACE SCI. 257, 258 (2005).

8. *Eliminating Conflict Diamonds*, DIAMONDFACTS.ORG, [http://diamondfacts.org/index.php?option=com\\_content&view=article&id=130&Itemid=168&lang=en](http://diamondfacts.org/index.php?option=com_content&view=article&id=130&Itemid=168&lang=en) (last visited Oct. 4, 2011) [hereinafter *The Kimberly Process*].

9. *Id.*

10. *Id.* This seems almost custom fit for electronic bills of lading. See *infra* Part III.C.1.

diamonds to other Kimberly participant countries.<sup>11</sup> Finally, if a shipment fails to conform to these standards, the shipments can be confiscated or rejected, and the shippers can be subject to criminal sanctions.<sup>12</sup> If concerns about a country's adherence arise to the process, an intergovernmental agency will investigate the situation.<sup>13</sup>

Conflict minerals are not good candidates for an analogous process for a number of reasons. Two major differences between conflict minerals and conflict diamonds are their size and nature. Diamonds are, by their nature, small, and essentially discrete items. Conflict minerals do not share these traits. Instead of small, easily controllable rocks, the eastern D.R. Congo exports thousands of tons in the form of raw, gravelly ore measured by the kilo.<sup>14</sup>

This means that packaging each individual "ore unit" in a tamper proof container is totally infeasible. Currently, ore is mostly shipped in bags, some of which may have a seal of approval from one organization or another.<sup>15</sup> These seals are very easy to forge since they are not uniform in practice. Additionally, once the ore has changed hands a number of times and been collected by larger resellers, the ore is a mix of conflict and non-conflict ore.<sup>16</sup>

There seems to be an overarching concern from the tin industry about continuing to buy conflict tin, but little interest from the other three industries. The International Tin Research Institute Ltd. (iTRi), the leading tin industry group,<sup>17</sup> has begun a pilot program for tracking conflict minerals, called iTSCi<sup>18</sup> and, aside from limited involvement from tantalum groups,<sup>19</sup> no other industry group has joined that effort.

## 2. Tungsten

Tungsten is used in x-ray tubes, photocopiers, laser printers, LCD panels, and the vibrate function in cellphones.<sup>20</sup> Approximately five-hundred metric tons of tungsten content ore were produced in the D.R. Congo in 2006 and 2007.<sup>21</sup> Tungsten comes from wolframite ore, which is where tungsten gets

11. *The Kimberly Process*, *supra* note 8.

12. *Id.*

13. *Id.*

14. See INST. FOR ENVTL. SEC., MINING, FOREST CHANGE AND CONFLICT IN THE KIVUS, EASTERN DEMOCRATIC REPUBLIC OF CONGO 8 (May 2008), available at [http://www.envirosecurity.org/espa/PDF/Mining\\_forest\\_change\\_and\\_conflict\\_in\\_the\\_Kivus.pdf](http://www.envirosecurity.org/espa/PDF/Mining_forest_change_and_conflict_in_the_Kivus.pdf) (last visited Oct. 4, 2011) (discussing mineral resources from eastern D.R. Congo).

15. Iain Marlow and Omar El Akkad, *Industry Groups Move to Clean Up Sourcing of 'Blood Minerals'*, THE GLOBE AND MAIL (Dec. 13, 2010, 6:51PM), <http://www.theglobeandmail.com/news/technology/industry-groups-move-to-clean-up-sourcing-of-blood-minerals/article1829018/>.

16. Aron Hall, *Rwanda's Gambit to Ban Congo Conflict Minerals*, ENOUGH (Apr. 29, 2011), <http://www.enoughproject.org/blogs/rwanda-gambit-ban-congo-conflict-minerals>.

17. iTRi, [http://www.itri.co.uk/SITE/UPLOAD/Document/ITRI\\_Brochure\\_Singles%202010.pdf](http://www.itri.co.uk/SITE/UPLOAD/Document/ITRI_Brochure_Singles%202010.pdf) (last visited Oct. 4, 2011).

18. *Supply Chains Unite to Start iTSCi Mineral Traceability Project in DRC*, iTRi (Mar. 19, 2010), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=999&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=999&Itemid=177).

19. *Id.*

20. *Electronic & Electrical Industry*, INT'L TUNGSTEN INDUS. ASS'N, <http://www.itia.info/Default.asp?Page=63> (last visited Oct. 4, 2011).

21. KIM B. SHEDD, US DEP'T OF THE INTERIOR, GEOLOGICAL SURVEY, 2008 MINERAL. Y.B., TUNGSTEN

the periodic table designation “W.”<sup>22</sup> Total world tungsten produced in 2006 and 2007 was approximately 56,000 metric tons.<sup>23</sup> Therefore the D.R. Congo’s reported contribution is about 1% of the world’s tungsten.

### 3. *Tantalum*

Tantalum is used in a number of electronic components, mostly capacitors.<sup>24</sup> Tantalum based capacitors can be thinner and lighter than traditional capacitors, and therefore are useful in electronics such as mobile phones and laptops.<sup>25</sup> About 42 metric tons were produced in the D.R. Congo in 2006 and about 267 in 2007.<sup>26</sup> Total tantalum production in 2006 and 2007 was 223,000 and 263,000 metric tons, respectively.<sup>27</sup> This means that tantalum from the D.R. Congo accounts for less than 0.5% of the world’s supply.<sup>28</sup>

### 4. *Tin*

Tin’s major uses include cans, containers, and electrical use, mostly in the form of solder.<sup>29</sup> In 2006 and 2007, approximately 3,800 and 8,900 metric tons of tin was produced by the D.R. Congo.<sup>30</sup> Total tin production in 2006 and 2007 was approximately 290,000 and 303,000 metric tons.<sup>31</sup> This means that the D.R. Congo was responsible for about 1% and 3% of the world’s tin production in 2006 and 2007.

### 5. *Gold*

Gold’s major uses are decorative, for use in jewelry, although it does play a major role in some electronics.<sup>32</sup> In 2006 and 2007, the D.R. Congo produced approximately ten thousand kilograms of gold annually.<sup>33</sup> Global

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[ADVANCE RELEASE] 79.20 (2010), available at <http://minerals.usgs.gov/minerals/pubs/commodity/tungsten/myb1-2008-tungs.pdf> [hereinafter TUNGSTEN].

22. *Wolframium Tungsten*, ELEMENTYMOLOGY & ELEMENTS MULTIDICT, <http://elements.vanderkrogt.net/element.php?sym=W> (last visited Oct. 4, 2010).

23. TUNGSTEN, *supra* note 21, at 79.20.

24. JOHN F. PAPP, U.S. GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES, TANTALUM 168 (2008), available at <http://minerals.usgs.gov/minerals/pubs/commodity/niobium/mcs-2008-tanta.pdf>.

25. *Id.*

26. MICHAEL W. GEORGE, US DEP’T OF THE INTERIOR, GEOLOGICAL SURVEY, 2008 MINERAL Y.B., NIOBIUM (COLUMBIUM) AND TANTALUM [ADVANCE RELEASE] 52.12 (2010), available at <http://minerals.usgs.gov/minerals/pubs/commodity/niobium/myb1-2008-niobi.pdf>.

27. *Id.*

28. *Id.*

29. JAMES F. CARLIN, JR., US GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES, TIN 176 (2008), available at <http://minerals.usgs.gov/minerals/pubs/commodity/tin/mcs-2008-tin.pdf>.

30. JAMES F. CARLIN, JR., US DEP’T OF THE INTERIOR, GEOLOGICAL SURVEY, 2008 MINERAL Y.B., TIN [ADVANCE RELEASE] 77.9 (2010), available at <http://minerals.usgs.gov/minerals/pubs/commodity/tin/myb1-2008-tin.pdf>.

31. *Id.*

32. *The Many Uses of Gold*, GEOLOGY.COM, <http://geology.com/minerals/gold/uses-of-gold.shtml> (last visited Oct. 4, 2011).

33. MICHAEL W. GEORGE, US DEP’T OF THE INTERIOR, GEOLOGICAL SURVEY, 2008 MINERAL Y.B., GOLD [ADVANCE RELEASE] 31.20 (2008), available at <http://minerals.usgs.gov/minerals/pubs/commodity/gold/myb1-2008-gold.pdf>.

gold production for 2006 and 2007 was 2,370,000 kilograms for each year.<sup>34</sup> Gold production by the D.R. Congo was less than .5% of total world production in 2006 and 2007.

Despite the relatively small fractions of the world's supply of each of the conflict minerals that are found in D.R. Congo, it is the bulk of the country's economy<sup>35</sup> and has funded abuses by armed groups such as child labor, forced labor, and rape throughout the eastern D.R. Congo.<sup>36</sup>

### B. *Armed Groups*

The term "armed groups" is used because it is not a single group in the area, but rather a spectrum of local organizations that are exploiting conflict minerals and the populaces nearby. The groups involved in exploitative mining practices include Congolese rebel groups, units of the Congolese National Army, local militias, and armed forces from neighboring Rwanda and Uganda.<sup>37</sup> To further confuse matters, there is cooperation between the different groups.<sup>38</sup> The groups have divided up different areas of the eastern Congo mines, share major roads, and even aid in supplying each other with arms, despite the fact that they publicly work towards opposing goals.<sup>39</sup>

The termed "armed groups" is a useful grouping of these distinct organizations because of their methods of control. In the mining areas, "armed groups" control local populaces by kidnap and rape, doing so at previously unheard of rates. United Nations figures cite 350 reported rape cases a month, a third of which are committed against children under eighteen.<sup>40</sup> As bad as these numbers are, societal issues aggravate them. Women who are raped are often abandoned by their husbands, outcast from society, and unable to access adequate physical and psychological treatment.<sup>41</sup> Additionally, these numbers are expected to represent only a fraction of the total amount of rapes perpetrated, as rapes are chronically unreported for fear of reprisal, social stigma, or the simple inability to report.<sup>42</sup>

The other characteristic that links these groups is the fact their major funding sources is the trade of conflict minerals. International Peace Service has identified thirteen major mines and two-hundred total mines in the eastern

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34. *Id.* at 31.21.

35. *Women in Artisanal Mining in the Democratic Republic of Congo*, PACT, <http://www.pactworld.org/galleries/default-file/Women%20in%20Artisanal%20Mining%20in%20the%20DRC.pdf> (last visited Oct. 4, 2010).

36. *Id.*

37. BSR, CONFLICT MINERALS AND THE DEMOCRATIC REPUBLIC OF CONGO 8 (2010), *available at* [http://www.bsr.org/reports/BSR\\_Conflict\\_Minerals\\_and\\_the\\_DRC.pdf](http://www.bsr.org/reports/BSR_Conflict_Minerals_and_the_DRC.pdf).

38. ALOYS TEGERA & DOMINIC JOHNSON, POLE INSTITUTE, RULES FOR SALE: FORMAL AND INFORMAL CROSS-BORDER TRADE IN EASTERN DRC 34 (May 2007), *available at* [http://www.pole-institute.org/documents/regard19\\_anglais.pdf](http://www.pole-institute.org/documents/regard19_anglais.pdf).

39. STEVEN SPITTAELS & FILIP HILGERT, INT'L PEACE INFO. SERV., MAPPING CONFLICT MOTIVES: EASTERN DRC 13 (2008), *available at* [http://www.ipisresearch.be/maps/Oost-Congo/20080506\\_Mapping\\_Eastern\\_DRC.pdf](http://www.ipisresearch.be/maps/Oost-Congo/20080506_Mapping_Eastern_DRC.pdf).

40. *Democratic Republic of Congo North Kivu: No End to War on Women and Children*, AMNESTY INT'L 6 (Sept. 2008), *available at* [http://www.amnestyusa.org/pdf/women\\_kivucongo.pdf](http://www.amnestyusa.org/pdf/women_kivucongo.pdf).

41. *Id.* at 7.

42. *Id.* at 6-7.

Congo region.<sup>43</sup> Of these mines, twelve of the thirteen major mines and 50% of the two-hundred total mines are controlled by armed groups.<sup>44</sup> This is clearly an unstable scenario with many self-interested actors. It is for these reasons that it is so difficult to account for the conflict minerals' origins. This situation needs new and better solutions.

### C. *What the United States is Doing*

#### 1. *Conflict Minerals Bill*

On July 21, 2010, President Obama signed the “Wall Street Reform and Consumer Protection Act” into law, a small portion of which was meant to deal with the use of “conflict minerals” in the D.R. Congo to fund militant groups with especially abhorrent human rights records.<sup>45</sup>

The relevant section of the bill was divided into two major parts. The first part, governed by the Security and Exchange Commission (“SEC”), requires publically listed companies to establish whether any of their products contain any conflict minerals, if those minerals came from a “conflict area”; and if so, it requires companies to describe how the minerals were determined to be as such.<sup>46</sup> The second part of the law is a mandate for the Secretary of State to put forth wider, non-mandatory advice on due diligence and other matters related to conflict mineral sourcing in the D.R. Congo.<sup>47</sup>

The SEC provision seems to be the more powerful provision as it gives mandatory due diligence requirements to all publicly traded companies in the United States.<sup>48</sup> The particulars of this standard are currently being established by SEC rule making open to comment practice and have not been established yet.<sup>49</sup>

#### 2. *Consumer Pressure*

As more information comes out about the human rights violations in the D.R. Congo, consumers, consumer electronics companies, and their component source producers desire to move away from the growing stigma. This has already led to Amalgamated Metals Corporation ceasing all purchasing in the D.R. Congo.<sup>50</sup> As advocates, such as the Enough Project,<sup>51</sup> call attention to

43. SASHA LEZHNEV & JOHN PRENDERGAST, ENOUGH, FROM MINE TO MOBILE PHONE: THE CONFLICT MINERALS SUPPLY CHAIN 2 (Nov. 10, 2009), available at <http://www.enoughproject.org/files/publications/minetomobile.pdf>.

44. *Id.*

45. Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111–203 §1502, 124 Stat. 1376 (codified as amended in 12 U.S.C.).

46. *Id.* §1502 (b).

47. *Id.* §1502 (c) (1) (A).

48. *Id.* §1502 (c) (1) (B) (ii).

49. *Specialized Disclosures: Title XV Provisions of the Dodd-Frank Wall Street Reform and Consumer Protection Act: Submitted Comments*, SEC, <http://www.sec.gov/comments/df-title-xv/specialized-disclosures/specialized-disclosures.shtml> (last visited Oct. 4, 2011).

50. *Thaisarco Suspends DRC Purchases*, ITRI (Sept. 18, 2009), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=1009&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=1009&Itemid=177).

51. A NGO that “conducts intensive field research in countries plagued by genocide and crimes against humanity, develops practical policies to address these crises, and shares sensible tools to help empower

consumer goods containing these materials and stigmatize them, it may become easier to just stop buying the minerals, but this would not give the social change that would be brought about by economically rewarding safe mining practices.

It is very difficult to thread this needle with the current advocacy campaigns. The Enough Project calls for consumers to ask for conflict free products from consumer electronics companies such as Apple, Dell, and Nintendo.<sup>52</sup> This style of campaign will likely cause companies to just purchase from exporters such as Amalgamated Metals who do not purchase from the Congo at all, resulting in a consumer-led embargo on D.R. Congo minerals. This would remove any potential control the western world could have over the mining practices of the D.R. Congo, and while it would defund the armed groups, it would also lead to greater poverty in the eastern D.R. Congo.

### 3. *Industry Pressure*

In contrast to the consumer/advocacy pressure, there is an attempt by industry to exercise different “due diligence” paradigms. These paradigms do not involve the stopping of sourcing of minerals from the D.R. Congo, but rather involve the tracing of where the minerals come from in the D.R. Congo and only accepting such minerals that did not go to funding armed groups in control of the mines.<sup>53</sup>

Industry has made these recommendations to the SEC. The major industry proposal is the iTSCi (ITRI Tin Supply Chain Initiative), put forward by ITRI. It is a rather pro-industry standard, calling for lighter due diligence burdens.<sup>54</sup>

iTSCi has garnered official support from the government of the D.R. Congo.<sup>55</sup> The first phase of iTSCi focuses only on the supply chain from the D.R. Congo exporter to the end manufacturer.<sup>56</sup> This means that the only due diligence from the mine to the exporter is a “declared mine [of] origin and transport route.”<sup>57</sup> The second phase of iTSCi tries to push the data gathering, with significant and vital support from D.R. Congo’s Ministry of Mines, further back upstream from the exporter to the mine, although it is unclear to what extent ITRI is willing or able to do this.<sup>58</sup> Taking a sample of how

citizens and groups working for change.” See *About Us*, ENOUGH, <http://www.enoughproject.org/about> (last visited Oct. 4, 2011).

52. *I’m a Mac . . . and I’ve Got a Dirty Secret*, ENOUGH, [http://www.enoughproject.org/conflict\\_areas/eastern\\_congo](http://www.enoughproject.org/conflict_areas/eastern_congo) (last visited Oct. 4, 2011).

53. E.g., ITRI, V1:15, IRTI ARTISANAL AND SMALL SCALE MINING POLICY (2008), [http://www.itri.co.uk/index.php?option=com\\_mtree&task=att\\_download&link\\_id=49614&cf\\_id=24](http://www.itri.co.uk/index.php?option=com_mtree&task=att_download&link_id=49614&cf_id=24).

54. Compare *id.* (stating the pro-industry proposal), with Global Witness Submission to the Securities and Exchange Commission at 1–3 (Oct. 2010), <http://www.sec.gov/comments/df-title-xv/specialized-disclosures/specializeddisclosures-30.pdf> (arguing for a more humanitarian alternative).

55. *DRC Ministry of Mines Reconfirms Official Support for iTSCi Mineral Traceability Project*, ITRI (June 11, 2010), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=995&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=995&Itemid=177).

56. *DRC Tin Supply Chain Initiative*, ITRI (July 10, 2009), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=1012&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=1012&Itemid=177).

57. *Id.*

58. *Supply Chains Unite to Start iTSCi Mineral Traceability Project in DRC*, ITRI (Mar. 19, 2010),



willing and able ITRI companies are to implement the second phase has also been complicated by the recent ban on all mining in North Kivu, South Kivu, and Maniema, regions that would be the major targets of the second phase of iTSCi.<sup>59</sup>

Groups such as Global Witness would like to see expansion of these due diligence paradigms. They point out that iTSCi does not require any monitoring of inter-D.R. Congo supply lines.<sup>60</sup> That is, between the mine, where the minerals are somehow certified, and the exporters, there is no oversight. This means that the militant groups that control the roads will be able to continue to collect illegal taxes for use of the roads.<sup>61</sup> Hard numbers about the extent of this illegal taxation are hard to find, but a recent study by Innovative Resource Management found that 92% of western Congo river traders' operating costs come from illegal taxation and fees, and of the 8% authorized, some of that doesn't make it to the state either.<sup>62</sup>

A second critique of the iTSCi scheme is that it relies heavily on the Congolese government for its implementation.<sup>63</sup> This is problematic for two similar but distinct reasons. First, relying on the D.R. Congo government to certify that mines are in "conflict zones" is an almost impossible task.<sup>64</sup> The very problem is that these mines are being fought over. If the government had the resources to control and monitor the mines, we would not need due diligence standards in the first place.<sup>65</sup> Additionally, there are signs that the D.R. Congo government might not be on board at all. On September 11, 2010 the president of the D.R. Congo banned all mining in North Kivu, South Kivu, and Maniema.<sup>66</sup> This not only put a halt to the iTSCi project, but also their funding, since a bulk of their funding is raised by a levy on tin exported from the D.R. Congo.<sup>67</sup>

An additional issue with the heavy reliance on the D.R. Congo government for the implementation of iTSCi is the Congolese Army.<sup>68</sup> The Congolese Army (French: Forces Armées de la République Démocratique du Congo (FARDC)) controls its own mines and roadways just like any other

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[http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=999&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=999&Itemid=177).

59. Lawrence Williams, *Banro's Gold Mine Development not Halted by DRC Mining Ban*, MINEWEB (Sept. 13, 2010), <http://www.mineweb.com/mineweb/view/mineweb/en/page66?oid=111138&sn=Detail>.

60. Melissa Pestilli, *Conflict Minerals: ITRI Supply Chain Initiative Fails to Address Major Issues*, TANTALUM INVESTING NEWS (Apr. 1, 2010), <http://tantaluminvestingnews.com/609/conflict-minerals-itri-supply-chain-initiative-fails-to-address-major-issues>.

61. *Id.*

62. Edward B. Rackley, *Predatory Governance in the DRC: Civilian Impact and Humanitarian Response*, HUMANITARIAN EXCHANGE MAG., Mar. 2005, at 33, 34, <http://www.odihpn.org/documents%5Chumanitarianexchange029.pdf>.

63. Pestilli, *supra* note 60.

64. *Id.*

65. Kingsley Orievulu, *Security situation in the DRC: A case of a weak state leaning on the UN*, CONSULTANCY AFRICA INTELLIGENCE (Sept. 16, 2010, 8:06 AM), [http://www.consultancyafrica.com/index.php?option=com\\_content&view=article&id=542:security-situation-in-the-drc-a-case-of-a-weak-state-leaning-on-the-un&catid=60:conflict-terrorism-discussion-papers&Itemid=265](http://www.consultancyafrica.com/index.php?option=com_content&view=article&id=542:security-situation-in-the-drc-a-case-of-a-weak-state-leaning-on-the-un&catid=60:conflict-terrorism-discussion-papers&Itemid=265).

66. *DRC Mining Ban Announced by President Kabila: Impact on iTSCi Project*, ITRI (Sept. 13, 2010), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=992&Itemid=177](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=992&Itemid=177).

67. *Id.*

68. Pestilli, *supra* note 60.

armed group in the eastern Congo.<sup>69</sup> However, outside of the capital, FARDC operates in relatively autonomous squads.<sup>70</sup> They do not receive regular funding from the capitol and instead fund themselves much in the same way as the other armed groups, by selling conflict minerals and controlling the transit routes.<sup>71</sup> There are widely reported human rights violations perpetuated by FARDC.<sup>72</sup> These violations range from intentionally targeting D.R. Congo citizens in attacks and systematic rapes<sup>73</sup> to illegal trafficking and taxing of conflict minerals,<sup>74</sup> defeating the purpose of using them to monitor at all.

Finally, the iTSCi scheme does not forbid doing business with exporters known to trade in conflict minerals.<sup>75</sup> The most notorious of such exporters are the Malaysia Smelting Corporation (MSC), the world's third largest tin producer, and Minerals Supply Africa (MSA), a Rwandan company founded by a UK businessperson.<sup>76</sup> Companies such as these could use the iTSCi as a mask to continue with normal business operations without any actual oversight.<sup>77</sup> Additionally, MSA has been accused by the UN of smuggling conflict minerals across the Rwandan border, a charge they deflect by claiming cooperation with the iTSCi, even though the iTSCi doesn't check in transit shipments.<sup>78</sup> Without reliable company-participants, iTSCi's reliability is called into question.

#### D. Technology Based Solutions

There are a number of technology based solutions that could be implemented to help enforce due diligence. Electronic bills of lading, chemical tagging, and chemical tracing seem to be the most promising methods. Nigerian "blood oil" provides an example of how technology based solutions enforce due diligence.

##### 1. Electronic Bills of Lading

One lesson that can be taken away from Nigerian "blood oil" is the use of electronic bills of lading.<sup>79</sup> Paper bills of lading are notoriously easy to forge, by changing either the contents of cargo containers or the amount of the materials in said containers. Combined with the fact that even the Congolese national security forces are on the take, without proper documentation, fraud will still run rampant.

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69. *Id.*

70. *Eastern DR Congo: Surge in Army Atrocities*, HUMAN RIGHTS WATCH (Nov. 2, 2009), <http://www.hrw.org/en/news/2009/11/02/eastern-dr-congo-surge-army-atrocities>.

71. *Id.*

72. *Id.*

73. *Id.*

74. *Id.*

75. Pestilli, *supra* note 60.

76. *Malaysia Smelting, Rwandan Company Are Main Buyers of Congo Tin*, INTELLASIA (Mar. 31, 2011, 7:00 AM), <http://www.intellasia.net/news/articles/resources/111290708.shtml> [hereinafter *Congo Tin*].

77. Pestilli, *supra* note 60.

78. *Congo Tin*, *supra* note 76.

79. JUDITH BURDIN ASUNI, U.S. INST. OF PEACE SPECIAL REPORT, BLOOD OIL IN THE NIGER DELTA 9 (Aug. 2009), available at [http://www.usip.org/files/blood\\_oil\\_nigerdelta.pdf](http://www.usip.org/files/blood_oil_nigerdelta.pdf).

A bill of lading is a document issued by the shipper of cargo to the owner of that cargo.<sup>80</sup> It has two main functions: it certifies that the goods have been received by the carrier,<sup>81</sup> and it serves as a transferable document of title.<sup>82</sup> The latter means that bills of lading can be and indeed are<sup>83</sup> exchanged for value as a way of reselling goods before the purchased goods have reached a port.

Additionally, a bona fide transferee who takes the instrument in good faith and for value acquires a good and complete title to the instrument and the rights it embodies, even if the transferor had a defective title or no title to it at all.<sup>84</sup> This is of particular relevance to conflict minerals, which often have a very cloudy transaction history.<sup>85</sup>

Electronic bills of lading are a more recent emergence. There have been several attempts that have met with problems in implementation.<sup>86</sup> Marek Dubvec summarizes the problem well:

Electronic bills of lading have not received the full support and confidence of all the participants in international business, predominantly due to concerns about security and the authenticity of such documents. Legally, it is difficult to develop an electronic document which has the function of negotiability and therefore allows for transfer of ownership from the seller to the buyer by delivery. It is also difficult to develop an electronic document that supports the creation of a security interest in the document itself or the underlying goods. In addition to the problems with the replication of the negotiability function in the electronic environment, the main stumbling block hindering utilization of electronic bills of lading seems to be the lack of modern registries where security interests granted with respect to these documents can be recorded. If electronic negotiability and collateral security are possible, then the other functions of a negotiable bill of lading could be undertaken by the same electronic means.<sup>87</sup>

## 2. *Chemical Tagging and Tracing*

Chemical tagging and tracing is an interesting solution. Even Steve Jobs mentioned that the use of chemical tagging of conflict minerals is the only way

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80. Hague-Visby Rules art. III, § 3, Feb. 23, 1968, available at <http://www.jus.uio.no/ln/sea/carriage.hague.visby.rules.1968/doc.html#11>.

81. *Id.* § 4.

82. WILLIAM WEGNER PORTER, A TREATISE ON THE LAW OF BILLS OF LADING § 417 (1891).

83. *Id.* at 305–06.

84. DENIS V. COWEN & LEONARD GERING, COWEN ON THE LAW OF NEGOTIABLE INSTRUMENTS IN SOUTH AFRICA 3 (4th ed. 1966).

85. See Damon van der Linde, *Putting an End to Conflict Minerals in the Congo*, TANTALUM INVESTING NEWS (Feb. 1, 2011), <http://tantaluminvestingnews.com/1178/putting-an-end-to-conflict-minerals-in-the-congo/> (discussing the goal of creating more responsible sourcing of minerals in the Democratic Republic of the Congo).

86. These included: SEADOCS, the Comité Maritime International (CMI) Rules, Bolero, @GlobalTrade, and TradeCard. For an excellent discussion of their pros and cons see Marek Dubvec, *The Problems and Possibilities for Using Electronic Bills of Lading as Collateral*, 437 ARIZ. J. INT'L & COMP. L. 437, 449–457 (2006).

87. *Id.* at 466.

to truly know their sourcing.<sup>88</sup> It is possible that the minerals can be chemically fingerprinted in the same way that Niger oil is fingerprinted; fingerprinting can identify characteristics and compositions that make it possible to certify not only that the raw ore is from eastern Congo, but also, possibly, even the specific mines.<sup>89</sup>

One of the biggest problems with conflict minerals is that they lack a discrete, easily packageable unit. That is, they do not come out of the ground in discrete units. Instead, the raw ore is placed in bags, which are then transported to the smelter.<sup>90</sup> The Congolese ore is then combined with ore from all over the world, making it indistinguishable from minerals sourced in other parts of the world.<sup>91</sup>

There are two approaches to chemical tags. The first is one that uses an additive “tag” to the ore, such that it will survive the refining process. The second uses natural trace chemical compositions of minerals to deduce where in the world certain raw materials are from.

a. Additive Chemical Tagging

Additive chemical tagging poses two large upfront technical problems: “Where to initially tag them?” and “How to tag them?” D.R. Congo “conflict free” minerals could be tagged with a unique chemical, possibly laced in the bag, that would chemically stamp the minerals as being “conflict free.” This could be as simple as mixing in a powder that is cheap, but unique within the ore. It does not have to be advanced radioactive isotope tagging. Since ore is essentially tiny rocks, adding a fine powder would be easy to do and very difficult to separate out.

b. Natural Trace Chemicals

Natural Trace Chemicals provide a better established technology, albeit with a different set of limitations. Steve Jobs has said that “[w]e require all of our suppliers to certify in writing that they use conflict free materials. But honestly there is no way for [us] to be sure. Until someone invents a way to chemically trace minerals from the source mine, it’s a very difficult problem.”<sup>92</sup> The good news is that such a technology has existed for quite some time.

Scientists have been able to trace the geographic origin of wine,<sup>93</sup> cocaine,<sup>94</sup> potatoes,<sup>95</sup> petroleum,<sup>96</sup> obsidian,<sup>97</sup> and gold.<sup>98</sup> The same techniques

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88. SENT BY STEVE JOBS (June 28, 2010), <http://sentbystevejobs.com/post/746438447/hi-steve-id-planned-to-buy-a-new-iphone>.

89. Asuni, *supra* note 79, at 8–9.

90. Lezhnev, *supra* note 43, at 6.

91. *Id.* at 6.

92. Hilary Howard, *Steve Jobs Statement on Conflict Minerals*, N.Y. TIMES (June 30, 2010, 2:06 PM), <http://kristof.blogs.nytimes.com/2010/06/30/steve-jobs-statement-on-conflict-minerals/>.

93. M. A. Brescia et al., *Characterization of the Geographical Origin of Italian Red Wines Based on Traditional and Nuclear Magnetic Resonance Spectrometric Determination*, 458 ANALYTICA CHIMICA ACTA 177, 185 (2002).

94. James R. Ehleringer et al., *Tracing the Geographical Origin of Cocaine*, 408 NATURE, 311, 311

should be able to be used to trace the origin of ores, given appropriate samples taken from mines.

These samples are analyzed using a variety of techniques, ranging from X-ray fluorescence, electron microprobe, neutron activation analysis, to a variety of mass spectrometries. The actual techniques involved in these processes are outside the scope of this article, but suffice it to say that each of these techniques have a different, non-negligible cost, that they require a varying level of scientific training to perform, and that a combination of them is needed to accurately determine a sample's geographic origins.

### III. ANALYSIS

This section will look at a number of different juxtapositions between conflict minerals and technology. First, it will discuss inferences that can be gleaned from conflict mineral data, as well as some oversights that have arisen in the current conflict minerals paradigm. Second, it will attempt to forecast what the due diligence layout will look like in the coming years and discuss its shortcomings. Finally, it will address how high-tech tracking techniques will help shore up these shortcomings.

#### A. Take Aways from Conflict Minerals Data

##### 1. Consumer Pressure

The D.R. Congo exports a large quantity of valuable minerals, especially for a country with a per capita GDP of \$190,<sup>99</sup> but this quantity does not constitute a substantial portion of the world's supply.<sup>100</sup> The bulk of the money generated is in tin and gold, neither of which have their greatest uses in electronics.<sup>101</sup>

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(2000), available at <http://www.nature.com/nature/journal/v408/n6810/pdf/408311a0.pdf>.

95. Kim A. Anderson et al., *Determining the Geographic Origin of Potatoes with Trace Metal Analysis Using Statistical and Neural Network Classifiers*, 47 J. AGRIC. FOOD CHEMISTRY 1568, 1568–1575 (1999).

96. See generally Hollis D. Hedberg, *Geologic Aspects of Origin of Petroleum*, 48 BULL. OF THE AM. ASS'N OF PETROLEUM GEOLOGISTS 1755, 1756 (1964).

97. See generally Robert H. Tychot, *Chemical Fingerprinting and Source Tracing of Obsidian: The Central Mediterranean Trade in Black Gold*, 35 ACCTS. CHEMICAL RES. 618, 619–620 (2002).

98. See generally T. Baker et al., *Chemical Compositions of Fluid Inclusions in Intrusion-Related Gold Systems, Alaska and Yukon, Using PIXE Microanalysis*, 101 ECON. GEOLOGY 311, 311–312 (2006); N. EYLES, *Characteristics and Origin of Coarse Gold in Late Pleistocene Sediments of the Cariboo Placer Mining District, British Columbia, Canada*, 95 SEDIMENTARY GEOLOGY 69, 69–71 (1995); Feng-Jun Nie et al., *Geological Features and Origin of Gold Deposits Occurring in the Baotou–Bayan Obo District, South-Central Inner Mongolia, People's Republic of China*, 20 ORE GEOLOGY REVIEWS 139, 140–142 (2002) (describing in detail the unique chemical features of gold sourced from different locations).

99. *Report for Selected Countries and Subjects*, INT'L MONETARY FUND, (Apr. 2010) <http://www.imf.org/external/pubs/ft/weo/2010/01/weodata/weorept.aspx?sy=2007&ey=2010&scsm=1&ssd=1&sort=country&ds=.&br=1&c=636&s=NGDPD,NGDPDPC,PPPGDP,PPPPC,LP&grp=0&a=&pr.x=72&pr.y=9>.

100. See *supra* text accompanying notes 21–33.

101. See *The Many Uses of Gold*, GEOLOGY.COM, <http://geology.com/minerals/gold/uses-of-gold.shtml> (last visited Oct. 4, 2011) (discussing the uses of gold); *ITRI Reports New Data on Global Tin Use and Recycling*, ITRI (Dec. 18, 2008), [http://www.itri.co.uk/index.php?option=com\\_zoo&task=item&item\\_id=1695&Itemid=65](http://www.itri.co.uk/index.php?option=com_zoo&task=item&item_id=1695&Itemid=65) (discussing uses of tin). See also *supra* Part II.A (discussing how much ore is mined from

Pressure directly on electronic companies will only help in a limited capacity. Since the bulk of the minerals do not actually go into electronics, even if the electronics companies refused to use conflict minerals, it would only slow the funding of the conflict, for tin can and jewelry producers would still readily purchase the goods. These manufacturers would be harder to control by consumer pressure, because there are many more names in the jewelry and tin can manufacturing business, and they are less focused on having a good brand name for themselves than say, a company like Apple. Additionally, even if consumer pressure allowed for companies to try to source elsewhere, there is little ability for them to monitor the origin of minerals. What is needed is a system with far-reaching transparency.

## 2. *The Problem with Grouping All Four Minerals Together*

There is also a problem with treating all four minerals identically under the heading “conflict minerals.” The amount produced and the value per ton for each mineral varies widely. This means that different due diligence schemes may be appropriate for each kind of mineral.

When all four minerals are lumped together into a single due diligence scheme, cracks in the protections readily appear. Perhaps the most salient example of this is what gold smugglers are doing. Since gold is so much more valuable per ounce than the other three minerals, it has begun to make financial sense for at least some smugglers to avoid the increasingly monitored ground routes and simply fly the gold over the border, circumventing all of the land based protections.<sup>102</sup>

### B. *Due Diligence Balance*

How do we allow companies to source materials from the eastern D.R. Congo and use their buying power to defund militant groups but not be so onerous that the companies simply pull out of the D.R. Congo whole hog? This creates a serious problem. One solution is that the U.S. government can use the SEC provision as a bare minimum and use the Secretary of State (“SOS”) provision as a premium option. By adopting an industry standard due diligence standard such as iTSCi for the SEC provision, the U.S. government can ensure that a bare minimum standard is adopted without causing companies to leave the D.R. Congo out of frustration.

In contrast to the mandatory SEC rules, the SOS would be able to offer expanded guidelines that would address criticisms of the ITRI scheme. A voluntary, complimentary certification scheme could create a value-added proposition for companies where image is paramount. Companies that sell on their “green” reputation would jump on the ability to “out green” the competition, and their customers would be less sensitive to a price increase.

This certification would start before the iTSCi certification does and have

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the ground for each mineral).

102. *DR Congo ‘Gold Smugglers’ Arrested in Goma*, BBC (Feb. 7, 2011), <http://www.bbc.co.uk/news/world-africa-12385910>.

to follow the minerals from mine to exporter, but could stay with the iTSCi certification where both were shared. Third-party auditing would be key to this scheme, as the combination of limited resources and corrupt government officials may be too great to overcome internally. Due to these difficulties, something is needed to supplement these methods.

### C. *High-Tech Solutions*

#### 1. *Electronic Bill of Lading*

Electronic bills of lading can provide a useful tool for tracking the origin of conflict minerals. Unlike traditional bills of lading, they are stored remotely and therefore are more resistant to forgery.

Electronic bills of lading have been offered by the U.S. government since 2006 and have been used successfully to combat fraudulent bookkeeping by shippers.<sup>103</sup> By adding a digitized certificate of origin to the bill of lading, the source of the ore can be traced back as far as the data allows.

This would require customs agencies based in major Congolese shipping ports in neighboring Rwanda and Uganda to adopt an electronic bill of lading standard, an infrastructural investment that, while significant, is not overly burdensome, and one that would also be of benefit to the industry in general, not just to the process of tracking conflict minerals.

#### 2. *Chemical Tagging/Tracing*

There is little on how chemical tagging and tracing could help. But with people like Steve Jobs calling for chemical tagging, it may be possible for advocacy groups to hold Apple to such statements; such pressure could force companies to develop chemical tagging by additive chemicals or chemical tracing by comparing the mineral with known samples.

Even in the Niger oil fingerprinting example, there is serious industry concern that the technology is not good enough to prevent very costly false positives.<sup>104</sup> There is also the problem of no international nor intercompany accepted standard for chemical classification to location translation. While ExxonMobil has done this to oil as far back as 1998, when it used geographical fingerprinting data to determine how much of their oil was spilled in an oil spill,<sup>105</sup> to have a similar, standardized system in place for conflict minerals would require either large scale cooperation between companies or additional infrastructure to create such standards. While this is certainly not an impossible feat, it would require a meeting of the minds of industry, science, and international policy makers to craft appropriate guidelines that balance accuracy and cost in a way that allows all parties to meet their goals.

However, given the initial research, this technique should work. Scientists were able to determine the origin of wines from different locations in

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103. ASUNI, *supra* note 79, at 9.

104. *Id.* at 8.

105. *Id.*

Apulia, a region in Italy less the 7,500 sq. miles.<sup>106</sup> For perspective, North Kivu alone is 22,967 sq. miles.<sup>107</sup>

#### IV. RECOMMENDATION

The recommendations put forward in this paper are three fold. First, the international community must come to terms with the realities of a required due diligence scheme, as mines, exporters, manufacturers, retailers, and end use consumers will only modify their habits to a certain degree. This is especially true since D.R. Congo is responsible for such a small portion of the world's tin, tungsten, tellurium, and gold, and thus, we must balance the burdens on acquiring the minerals with the risk that the world will simply source the ore elsewhere. Several companies, such as Thaisarco, a large tin smelter and Amalgamated Metals, have already stopped sourcing minerals from the eastern Congo.

This is best done through a controlled implementation of low cost, easy to use, but hard to forge, technological solutions.

##### A. *Due Diligence Realities—Technological Solutions as Modular*

The iTRe schema is likely to rule the day when it comes to American law. This means that companies will be forced to do very little by current American law. This makes adopting a technological approach that much more important. While law requires that all actors conform their actions to a uniform standard, modular technological solutions allow each company to adopt a different and still enforceable path.

For example, using electronic bills of lading, which indelibly certify minerals as conflict free, works well when the concerned parties have control from the original port of shipping, typically out of Uganda. It does not certify that the minerals have been removed from a mine that doesn't fund armed groups, or that excessive "taxes" were not paid on the shipping costs. What an electronic bill of lading will do, however, is take the exporter's word that they are sourced conflict free, which is done under most proposed schemes, and mark it to a shipment as it goes to the smelter. Smelters are often guilty of masking the origin of conflict minerals, either because it is too difficult to keep track of individual D.R. Congo exporters, or it just pays to not look too closely.

This is in contrast to an additive-type chemical tagging, useful for artisanal mining operations, concerned with marking their mines as conflict free. By adding a powder of specific chemical make up to a bag, artisanal mines can leave a unique origination signature that would be difficult to replicate or combine with other shipments. The additive would survive the check points, which is both a pro and a con. On the pro side, without labor or equipment the additive could be difficult to detect by armed groups, which would prevent them from discriminating against ore that did not come from

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106. *Provinces of Italy*, STATOIDS (Sept. 11, 2011), <http://www.statoids.com/uit.html>.

107. *Provinces of the Democratic Republic of Congo (Congo Kinshasa)*, STATOIDS (July 30, 2011) <http://www.statoids.com/ucd.html>.



their mines. On the con, the additive still does little to nothing to certify that illegal taxes and bribes that support armed groups' control of the region were not paid.

The trace-chemical analysis technique would, however, allow smelters to sample loads that they receive to determine geographic origin providing more assurances than currently exist.

### *B. Barriers to Entry—Technological Solutions as Low Impact*

One of the major advantages of the technology based solutions proposed is that there is a low cost of entry and few players need to be involved. The technology implementation does not require the massive international cooperation that the Kimberly Certification requires.<sup>108</sup> Instead, the parties can be as limited as partners involved in a particular supply chain, or, in the case of electronic bills of lading, just have pre-established infrastructure that can be expanded a step back.

Electronic bills of lading require the most extensive infrastructure to implement, but much less so the Kimberly Certification process.

Chemical additive tagging can be used with only inter-supply chain infrastructure. It only requires the end user, be it smelter, or someone further up the stream, to supply an additive to approved mines. Supplying the additive simply requires the same mine visits that would be required to ensure that the mines are conflict free.

Trace chemical analysis requires only a single visit, or even simply a sample shipped from a trustworthy source.

### *C. Data and Honesty—Technological Solutions as High Accuracy*

The other side of the technical benefit has to do with the increased accuracy of technological methods. This comes in two ways: raw data and difficulty to forge.

#### *1. Raw Data*

The three techniques discussed can deeply benefit the gathering of raw data to better understand the sources and pathways of conflict minerals into western consumer goods. One of the biggest problems with supply chain auditing is getting an accurate and honest baseline. When goods are smuggled across countries, it becomes almost impossible to determine where the goods were extracted from without some of these processes, and trace chemical analysis should be well suited to this goal.

If smelters were to sample loads at they received them using a trace chemical analysis technique that allowed the smelter to know with a high level of accuracy where the ore came from, it would be useful not just to protect against human rights violations, but would also allow the smelter to maximize efficiency when sourcing materials. If, for example, a smelter decided to

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108. See *supra* notes 8–13 and accompanying text (describing the Kimberly Process).

expand upstream and ship to itself, it would know exactly where the shipments come from upstream, offering additional revenue sources to itself.

## 2. *Difficulty to Forge*

Electronic bills of lading serve two similar but distinct purposes when it comes to forging. The first is to hinder the forging of paper bills of lading. The second is to provide an early certification that stays with the ore throughout the process.

Chemical additives address the concerns about the ability to forge. The exact chemical makeup and physical structure of an ideal tracing chemical is beyond the scope of this paper. However, an ideal chemical would be easy to mix in the pile of pebbles that is raw ore and difficult to separate. It need not chemically bind. It should be cheap, but unique. It can be supplied to the mines by third-party auditors or end user smelters or manufactures. The chemical should be easy to separate from the ore itself.

Trace chemical should be almost impossible to forge. The data is gathered from properties intrinsic to the area in which the ore was mined. One can imagine schemes that would cheat this system, if the test is done by the receiving party, and not simply done by the shipper and the shipper passes along a certificate, the system should be very hard to fool.

### *D. Tying it together*

Any one of these techniques may not be enough, and the three techniques discussed here are by no means an exhaustive list of technology based solutions that could help alleviate the supply chain problems in dealing with conflict minerals. But if a holistic approach is taken, in which different techniques are tried out in small scale, real life applications, a good solution, or battery of solutions could be found that would give much needed transparency to the “ground to smelter” part of the supply chain.

## V. CONCLUSION

Eastern D.R. Congo is in a very tough place. The bulk of its industry is in its exportation of natural resources and the country essentially does not have the resources to control areas outside of its capitol. Ways to “bless” its minerals outside of a central government need to be developed. Each of the proposed technological solutions would provide this to an extent. The electronic bills of lading give concerned parties’ confidence in the origination of goods and can track the shipment back to a port of origin. Chemical additive tracing gives the much sought after “from the mine” origination in a potentially totally indelible manner. Analysis of trace chemical geographical fingerprinting may give less precise data, but would almost certainly be able to detect minerals that were from different provinces in eastern D.R. Congo.

With any system, there are serious startup costs. Electronic bills of lading, while accepted in the U.S., have not been accepted worldwide, let alone with fields that track each bill back to the mine. This is feasible, but would

require international will. Chemical additive tracing needs some research done to find a substance that will mix well with ore, as well as either refine out of the final product easily or have no negative effect on the final product's purposes. Geographic finger printing is a well established science, but there is little research on using it on any of the "three-T" ores. It is also dependent on geographic non-uniformity and the ability to take samples to prove as such.

Despite these barriers, these proffered technological solutions offer hope of being able to properly track minerals coming out of conflict zones such as the D.R. Congo, and would also allow purchasers of minerals to get a detailed picture of where their ore comes from, all the way back to the ground. This information may be worth the investment on its own in some circumstances, such as when a smelter wants to take control of its shipping, or a shipper wants to become its own D.R. Congo domestic exporter. It would take a lot of the mystery out of where ore comes from, not just to avoid funding abuses by armed groups, but to better run one's own business. Any of these solutions alone, and especially a combination, would provide not just a great resource in combatting conflict minerals in the D.R. Congo, but also to prevent resources from all over the world from being used to fund human rights abuses.